DEPARTMENT OF INTEGRATIVE BIOLOGY

Mission Statement
The mission of the Department of Integrative Biology is to educate, inspire, and assist students and regional diverse populations through a comprehensive curriculum, emergent pedagogy, and collaborative research. We focus on the complexity and factors that influence life and we strive to understand how the processes that sustain life and enable biological innovation operate and interact within and across different scales of organization: from molecules to cells, tissues to organisms, species, ecosystems, biomes, and the Earth.

General Information
Faculty conduct research related to how environments affect cells, microbes, plants, animals, and ecosystems. Researchers’ interests range from cell growth, development, and reproduction, to the effects of hormones on plant growth and plant development, to signaling between plants, to ecology. The department also has a strong core of faculty interested in the conservation and restoration of our natural resources, including soil health, river restoration, and wildlife habitat.

Degrees
The Department of Integrative Biology offers the following degrees:

- Bachelor of Science degree in Biology
  - Concentration in Cell and Molecular Biology
  - Concentration in Ecology
  - Concentration in Plant Biology
  - Concentration in Premedical Sciences
  - Concentration in Grades 7–12 Biology Teacher Certification in collaboration with UTeachSA
- Bachelor of Science degree in Environmental Science
- Bachelor of Arts degree in Environmental Studies
- Bachelor of Science in Multidisciplinary Science with Grades 7–12 Science Teacher Certification (in collaboration with UTeachSA)
- Minor in Biology
- Minor in Environmental Science

To create a well-rounded graduate, students are encouraged to get involved in research and outreach activities as soon as possible.

Educational Objectives
Upon graduation, students in Department of Integrative Biology programs will be able to:

- Explain foundational concepts related to the specific degree.
- Apply the process of scientific inquiry.
- Demonstrate critical thinking skills.
- Use appropriate field and/or laboratory methods to collect quality data.
- Use appropriate quantitative and qualitative methods to evaluate scientific data.
- Demonstrate ability to work effectively in a team with others from diverse disciplines and backgrounds.
- Effectively communicate scientific information, and the relationship between science and society, to a diverse audience through oral, written, and visual means.

Health Careers Pathways
The Department of Integrative Biology offers programs that supports students interested in pursuing professional or graduate programs (e.g., medical, dental, pharmacy and veterinarian) in health-related professions. See the Degrees (p. 1) page for more information. Students can also visit the UTSA Health Professions office (https://www.utsa.edu/healthprofessions/) for more information.

Sophomore Biology Research Initiative (SBRI)
The Sophomore Biology Research Initiatives offers eligible second-year students to engage in authentic research with faculty and graduate students while earning academic credit. The opportunity to be part of the SBRI is limited, so students should register early. See the Degrees (p. 1) page for more information about SBRI.

- B.S. Degree in Biology (p. 1)
  - Concentration in Cellular and Molecular Biology (p. 4)
  - Concentration in Ecology (p. 4)
  - Concentration in Plant Biology (p. 4)
  - Concentration in Premedical Sciences (p. 4)
  - Concentration in 7-12 Biology Teacher Certification (p. 5)
- B.S. Degree in Environmental Science (p. 9)
- B.A. Degree in Environmental Studies (p. 13)
- B.S. Degree in Multidisciplinary Science (p. 15)

Bachelor of Science Degree in Biology
The Bachelor of Science (B.S.) Degree in Biology is designed to prepare students for professional careers in the biological sciences, medical and health service fields, research, industry, and education. For students planning to attend medical, dental, or graduate school in biological and applied sciences, this major provides a strong foundation in the basic life sciences. The program of study is structured around a comprehensive curriculum that includes genetics, physiology, cell biology, chemistry, physics, computer science, and mathematics. This foundational knowledge along with laboratory experience prepares students for research and technical positions in universities, government, and industry. At the upper-division level, students wanting to specialize can choose from five concentrations: Cellular and Molecular Biology, Ecology, Plant Biology, Premedical Sciences, and Grades 7–12 Biology Teacher Certification. The degree also offers a pathway to Physical Therapy doctoral programs and Physician Assistance master’s programs.

Some of the careers a B.S. Degree in Biology will prepare students for are animal scientist, biochemist, bio-engineer, biometrician, botanist, chiropractor, dentist, ecologist, food scientist technologist, forester, medical librarian, medical technologist, microbiologist, molecular biologist, neurobiologist, ophthalmologist, optometrist, pharmaceutical salesperson, pharmacy technician, physical therapist, physician, physician assistant, radiation technologist, research scientist, science teacher, park naturalist, test and inspection technician, veterinarian, wildlife biologist, zoologist, or a zoo or aquarium administrator.

The minimum number of semester credit hours required for the B.S. degree in Biology, including the Core Curriculum requirements, is 120. To
Complete the Grades 7-12 Biology Teacher Certification Concentration requires a minimum of 124 semester credit hours.

Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work courses and the required prerequisites must be completed with a grade of "C-" or better.

**Program Outcomes**

Graduates of the B.S. Degree in Biology program will be able to:

- Explain foundational concepts in biology, including evolution, cell theory, the chemical basis of life, expression and transmission of genetic information, energy transfer and transformation, integration of living systems, and species diversity.
- Explain the relationship between structure and function at all levels of biological organization, including molecular, cellular, organismal, population, and ecosystem levels.
- Apply the process of scientific inquiry.
- Use appropriate field and/or laboratory methods to collect quality data.
- Use appropriate quantitative and qualitative methods to evaluate biological data.
- Demonstrate critical thinking skills in relation to biological issues.
- Demonstrate ability to work effectively in a team with others from diverse disciplines and backgrounds.
- Effectively communicate scientific information, and the relationship between science and society, to a diverse audience through oral, written, and visual means.

**Sophomore Biology Research Initiative**

Students may apply to participate in the Sophomore Biology Research Initiative. After acceptance, students will take BIO 2953 Special Topics in Biology followed by BIO 3053 Sophomore Research Experience during their sophomore year after completing their first 30 hours. Students should apply after their first semester. A total of six hours will be completed. BIO 2953 Special Topics in Biology will replace the required laboratories Molecular Genetics Laboratory (BIO 2362) and Molecular Biochemistry Laboratory (BIO 3362). During their junior year, students are encouraged to take BIO 3382 Sophomore Research Initiative Peer Mentor and serve as a mentor to sophomore students. SBRI allows students to engage in authentic research with faculty and graduate students. Students working in teams will conduct their research projects on a specific biological problem over two semesters. Several different research topics will be available to choose from. There will be approximately two hours of lecture/lab meeting and six hours of lab work per week. Students will present their final data in poster format at an organized symposium. The opportunity to be part of the SBRI is limited, so students should register early.

**Health Career Pathways**

For those students interested in using a biology degree as a pathway to health-related professional school, it is important to remember that each medical, dental, or other health-related professional school determines its course requirements for admission. There is a significant similarity within each of these professional schools, but differences do occur. Students should refer to the respective school of interest website for the official and most current requirements for that particular school.
Gateway Courses

Students pursuing the B.S. Degree in Biology must complete each of the following Gateway Courses with a grade of "C-" or better in no more than two attempts. A student who is unable to complete these courses within two attempts, including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change his or her major.

Students pursuing the Concentration in Grades 7–12 Teacher Certification can substitute STA 1053 for both MAT 1193 and STA 1403.

Required mathematics and statistics courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT 1193</td>
<td>Calculus for the Biosciences</td>
<td>6</td>
</tr>
<tr>
<td>STA 1403</td>
<td>Probability and Statistics for the Biosciences</td>
<td>3</td>
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</table>

Degree Requirements

A. Required courses in the major

1. Biology requirements:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 1203</td>
<td>Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors</td>
<td>8</td>
</tr>
<tr>
<td>BIO 1223</td>
<td>Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors</td>
<td>12</td>
</tr>
<tr>
<td>BIO 2313</td>
<td>Genetics</td>
<td>3</td>
</tr>
</tbody>
</table>

2. Advanced Laboratory options:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 2362</td>
<td>Molecular Genetics Laboratory</td>
<td>4-6</td>
</tr>
<tr>
<td>BIO 3362</td>
<td>Molecular Biochemistry Laboratory</td>
<td></td>
</tr>
<tr>
<td>BIO 2953</td>
<td>Special Topics in Biology (taken two times in consecutive semesters for a total of 6 hours)</td>
<td>6</td>
</tr>
</tbody>
</table>

3. Biology electives:

Additional biology electives at the upper-division level

For students interested in focusing on computational biology, we recommend BIO 3523 Advanced Computational Biology and BIO 3253 R Coding in Environmental Science and Ecology

B. Support work

The support courses listed below are mandatory prerequisites for various biology courses starting in a student's sophomore year. Students need to complete their support work as soon as possible, in their freshman and sophomore years, to be eligible to register for upper-division biology core courses and electives. Failure to complete the support courses listed below in a timely fashion will significantly delay a student's progress toward graduation.

1. Required chemistry courses:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 1103</td>
<td>General Chemistry I and General Chemistry I Laboratory</td>
<td>16</td>
</tr>
<tr>
<td>CHE 1113</td>
<td>General Chemistry II and General Chemistry II Laboratory</td>
<td>16</td>
</tr>
</tbody>
</table>

C. Free electives

Select 6 semester credit hours of free electives, depending on the laboratory sequence chosen under section A2, to complete 120 hours. 1-4 credit hours must be at the upper-division level to reach the minimum requirement of 39 upper-division semester credit hours.

Students pursuing the Concentration in Grades 7–12 Teacher Certification will take required courses for teacher certification in lieu of free electives (see concentration requirements below). Students interested in focusing on computational biology should take ES 2113 - Geographical Information Systems

Total Credit Hours 90-92

*Note: Students in the Concentration in Grades 7-12 Teaching Certification have a defined program of study outlined below. Physics laboratories noted by an asterisk (*) are not required for the Concentration in Grades 7-12 Teaching Certification.

Concentrations

For students interested in research, teaching, graduate, or professional programs, the Department of Integrative Biology offers five concentrations. To declare a concentration or obtain advice, students should consult an undergraduate advisor in Life and Health Sciences Advising. If a student takes any of the courses listed below that satisfy the Biology degree and concentration, the student may need to take additional upper-division Biology courses to meet the minimum number of semester credit hours required for the Biology degree. Students who
do not satisfy all requirements of a given concentration will receive a general B.S. Degree in Biology.

**Concentration in Cell and Molecular Biology**
The coursework within the Concentration in Cell and Molecular Biology must be completed with a minimum cumulative grade point average of 3.0 or better. Students are also encouraged to enroll in BIO 4923 Laboratory Research: Biology Concentrations as part of their program of study. More information can be found in the Department of Neurosciences, Development and Regenerative Biology. (http://catalog.utsa.edu/undergraduate/sciences/neuroscience/)

All candidates for the Concentration in Cell and Molecular Biology must complete the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3913</td>
<td>Molecular Biology</td>
<td>3</td>
</tr>
<tr>
<td>or NDRB 3913 Molecular Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO 3663</td>
<td>Human Embryology</td>
<td>3</td>
</tr>
<tr>
<td>or NDRB 3663 Human Embryology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Select three of the following:</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>BIO 3933</td>
<td>Principles of Cancer Biology</td>
<td></td>
</tr>
<tr>
<td>or NDRB 3993 Principles of Cancer Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO 4143</td>
<td>Developmental Biology</td>
<td></td>
</tr>
<tr>
<td>or NDRB 4143 Developmental Biology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO 4453</td>
<td>Endocrinology</td>
<td></td>
</tr>
<tr>
<td>or NDRB 4453 Endocrinology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO 4723</td>
<td>Virology</td>
<td></td>
</tr>
<tr>
<td>or MMI 4723 Virology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO 4743</td>
<td>Immunology</td>
<td></td>
</tr>
<tr>
<td>or MMI 4743 Immunology</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BIO 4923</td>
<td>Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in molecular biology research.)</td>
<td></td>
</tr>
<tr>
<td>or MMI 4923 Laboratory Research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>or NDRB 4923 Laboratory Research</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NDRB 3463</td>
<td>Brain Diseases</td>
<td></td>
</tr>
<tr>
<td>NDRB 4153</td>
<td>Frontiers in Pluripotent Stem Cells</td>
<td></td>
</tr>
<tr>
<td>NDRB 4483</td>
<td>Developmental Neuroscience: From Zygote to Brain Circuits</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credit Hours** 14

**Concentration in Ecology**
The coursework within the Concentration in Ecology must be completed with a minimum cumulative grade point average of 3.0 or better. Students are also encouraged to enroll in BIO 4923 Laboratory Research: Biology Concentrations as part of their program of study.

All candidates for the Concentration in Ecology must complete the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3343</td>
<td>Plant Cell Biology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 4313</td>
<td>Plant Physiological Ecology</td>
<td>3</td>
</tr>
<tr>
<td>Select three of the following:</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>BIO 3263</td>
<td>The Woody Plants</td>
<td></td>
</tr>
<tr>
<td>BIO 3273</td>
<td>Biology of Flowering Plants</td>
<td></td>
</tr>
<tr>
<td>BIO 3333</td>
<td>Plants and Society</td>
<td></td>
</tr>
<tr>
<td>BIO 4283</td>
<td>Plant-Soil-Microbe Interactions</td>
<td></td>
</tr>
<tr>
<td>BIO 4643</td>
<td>Medicinal Plants</td>
<td></td>
</tr>
<tr>
<td>BIO 4923</td>
<td>Laboratory Research: Biology Concentrations (Research must be in a laboratory engaged in plant-based research.)</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credit Hours** 15

**Concentration in Premedical Sciences**
The B.S. degree in Biology with a Concentration in Premedical Sciences is designed to prepare students for professional programs in medicine, dentistry, pharmacy, or veterinary science. This concentration has a recommended curriculum that is designed to meet the requirements for entry into these professional schools and to prepare students for the MCAT, DAT, PCAT, or GRE examinations. The coursework within the Concentration in Premedical Sciences must be completed with a

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3283</td>
<td>Principles of Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 3292</td>
<td>Principles of Ecology Laboratory</td>
<td>2</td>
</tr>
<tr>
<td>Select three of the following:</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>BIO 3073</td>
<td>Environmental Rhetoric and Technical Communication</td>
<td></td>
</tr>
</tbody>
</table>

**Total Credit Hours** 15
minimum cumulative grade point average of 3.0 or better. All candidates for the Concentration in Premedical Sciences must complete the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 2992</td>
<td>Medical Terminology</td>
<td>2</td>
</tr>
<tr>
<td>BIO 3013</td>
<td>Introduction to Clinical Medicine and Pathology</td>
<td>3</td>
</tr>
<tr>
<td>or MMI 3013</td>
<td>Introduction to Clinical Medicine and Pathology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 3433</td>
<td>Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>or NDRB 3433</td>
<td>Neurobiology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 3643</td>
<td>Advanced Physiology I and Clinical Anatomy Laboratory I</td>
<td>5</td>
</tr>
<tr>
<td>&amp; BIO 3642</td>
<td>Advanced Physiology II and Clinical Anatomy Laboratory II</td>
<td>5</td>
</tr>
<tr>
<td>BIO 3663</td>
<td>Human Embryology</td>
<td>3</td>
</tr>
<tr>
<td>or NDRB 3663</td>
<td>Human Embryology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 3713</td>
<td>Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>or MMI 3713</td>
<td>Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 4473</td>
<td>Advanced Clinical Medicine and Pathology</td>
<td>3</td>
</tr>
<tr>
<td>or MMI 4473</td>
<td>Advanced Clinical Medicine and Pathology</td>
<td>3</td>
</tr>
<tr>
<td>PSY 1013</td>
<td>Introduction to Psychology (meets Core Curriculum requirement for Social and Behavior Component Area)</td>
<td>3</td>
</tr>
</tbody>
</table>

Total Credit Hours: 30

**Concentration in Grades 7–12 Biology Teacher Certification**

The B.S. degree in Biology with a Concentration in Grades 7–12 Biology Teacher Certification is designed to prepare students for professional careers in teaching Biology at the level of secondary education. The program of study is structured around a comprehensive Biology curriculum and state requirements for grades 7–12 life science teaching certification. Students cannot receive a B.S. degree with Teacher Certification without completing the teacher certification coursework. A student who does not complete the Biology teacher certification must transfer to the B.S. degree in Biology, B.S. in Neurosciences, or the B.S. degree in Microbiology and Immunology to receive a degree in Biology.

The minimum number of semester credit hours required for the B.S. degree in Biology with Teacher Certification, including the Core Curriculum requirements, is 124. Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level. The coursework within the Concentration in Grades 7–12 Biology Teacher Certification must be completed with a minimum cumulative grade point average of 2.5 or better.

**Criminal Background Check**

Teacher preparation programs at UTSA require fieldwork in public schools. This requires that a student be able to pass a criminal background check conducted by the school districts. It is the responsibility of the student to determine if their criminal history background will present a problem before applying for admission to the teacher preparation program. Students with a problematic criminal history will encounter difficulty in completing any fieldwork requirements and may not be able to complete the program.

All candidates for the Concentration in Grades 7–12 Biology Teacher Certification must complete the following:

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3283</td>
<td>Principles of Ecology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 3323</td>
<td>Evolution</td>
<td>3</td>
</tr>
<tr>
<td>BIO 3713</td>
<td>Microbiology</td>
<td>3</td>
</tr>
<tr>
<td>BIO 4813</td>
<td>Brain and Behavior</td>
<td>3</td>
</tr>
<tr>
<td>ESL 3083</td>
<td>Second Language Teaching and Learning for Grades 7-12</td>
<td>3</td>
</tr>
<tr>
<td>LTED 3773</td>
<td>Reading and Writing Across the Disciplines- Grades 7–12</td>
<td>3</td>
</tr>
<tr>
<td>SPE 3603</td>
<td>Introduction to Special Education</td>
<td>3</td>
</tr>
<tr>
<td>UTE 1111</td>
<td>Introduction to STEM Teaching Step 1</td>
<td>1</td>
</tr>
<tr>
<td>UTE 1122</td>
<td>Introduction to STEM Teaching Step 2</td>
<td>2</td>
</tr>
<tr>
<td>UTE 3023</td>
<td>Perspectives on Science and Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>UTE 3203</td>
<td>Knowing and Learning in Mathematics and Science</td>
<td>3</td>
</tr>
<tr>
<td>UTE 3213</td>
<td>Classroom Interactions</td>
<td>3</td>
</tr>
<tr>
<td>UTE 4203</td>
<td>Project-Based Instruction</td>
<td>3</td>
</tr>
<tr>
<td>UTE 4646</td>
<td>Clinical Teaching</td>
<td>6</td>
</tr>
</tbody>
</table>

Total Credit Hours: 42

**Course Sequence Guide for B.S. Degrees in Biology**

**B.S. in Biology – Recommended Four-Year Academic Plan for the General B.S. in Biology or Concentrations in Cell & Molecular Biology, Ecology, or Plant Biology.**

See below for the recommended four-year plan for students accepted to the Sophomore Biology Research Initiative, Concentration in Premedical, or Concentration in Grades 7-12 Biology Teaching Certification.

This course sequence guide is designed to assist students in completing their UTSA general B.S. degree in Biology or with concentrations in Cell & Molecular Biology, Ecology, or Plant Biology. *This course sequence is only a guide and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. **Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

**First Year**

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>AIS 1203</td>
<td>3</td>
</tr>
<tr>
<td>BIO 1203 &amp; BIO 1201</td>
<td>4</td>
</tr>
<tr>
<td>CHE 1103 &amp; CHE 1121</td>
<td>4</td>
</tr>
<tr>
<td>WRC 1013</td>
<td>3</td>
</tr>
<tr>
<td><strong>Total Credit Hours</strong></td>
<td>14</td>
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</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 1223 &amp; BIO 1221</td>
<td>4</td>
</tr>
</tbody>
</table>
### B.S. in Biology – Recommended Four-Year Academic Plan for Students Participating in Sophomore Biology Research Initiative

This course sequence guide is designed to assist students in completing their UTSA B.S. Degree in Biology for students participating in the Sophomore Biology Research Initiative. **This course sequence is only a guide and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans. Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. Students may choose to take courses during Summer terms to reduce course loads during long semesters.**

#### First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credit Hours</th>
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</thead>
<tbody>
<tr>
<td>AIS 1203</td>
<td>3</td>
</tr>
<tr>
<td>BIO 1203 &amp; BIO 1201</td>
<td>4</td>
</tr>
<tr>
<td>CHE 1103 &amp; CHE 1121</td>
<td>4</td>
</tr>
<tr>
<td>WRC 1013</td>
<td>3</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Spring</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIO 3513</td>
<td>3</td>
</tr>
<tr>
<td>BIO 3362</td>
<td>2</td>
</tr>
<tr>
<td>Government-Political Science (core)</td>
<td>3</td>
</tr>
<tr>
<td>Creative Arts (core)</td>
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</tr>
<tr>
<td>Upper-division BIO elective (3xx3)</td>
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#### Second Year

<table>
<thead>
<tr>
<th>Fall</th>
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</tr>
</thead>
<tbody>
<tr>
<td>BIO 2313</td>
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<tr>
<td>BIO 2362</td>
<td>2</td>
</tr>
<tr>
<td>CHE 2603</td>
<td>5</td>
</tr>
<tr>
<td>STA 1403</td>
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<table>
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<tr>
<td>PHY 1603 &amp; PHY 1611</td>
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<tr>
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<td>PHY 1943 &amp; PHY 1951</td>
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#### Third Year

<table>
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<td>COM 2113</td>
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<td>PHY 1963 &amp; PHY 1971</td>
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<tr>
<td>PHY 1623 &amp; PHY 1631</td>
<td>Algebra-based Physics II Laboratory</td>
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| American History (core) | 3 |
| Language, Philosophy & Culture (core) | 3 |

#### Fourth Year

<table>
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<th>Credit Hours</th>
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<tbody>
<tr>
<td>Upper-division BIO elective</td>
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<tr>
<td>Students in the Cell and Molecular Biology Concentration should take BIO 3663 or NDRB 3663 Human Embryology</td>
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<tr>
<td>Free upper-division elective</td>
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</tbody>
</table>

Note: Some courses are only offered once a year; Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.
## First Year

### Fall
- **BIO 1203**  
  Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors (core and major)  
  **Credit Hours**: 4
- **CHE 1103**  
  General Chemistry I and General Chemistry I Laboratory  
  **Credit Hours**: 4
- **WRC 1013**  
  Freshman Composition I (core)  
  **Credit Hours**: 3

### Spring
- **BIO 1223**  
  Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors (core and major)  
  **Credit Hours**: 4
- **CHE 1113**  
  General Chemistry II and General Chemistry II Laboratory  
  **Credit Hours**: 4
- **MAT 1193**  
  Calculus for the Biosciences (core and major)  
  **Credit Hours**: 3
- **WRC 1023**  
  Freshman Composition II (core)  
  **Credit Hours**: 3

### Second Year

#### Fall
- **BIO 2313**  
  Genetics  
  **Credit Hours**: 3
- **BI 2953**  
  Special Topics in Biology (SBRI)  
  **Credit Hours**: 3
- **CHE 2603**  
  Organic Chemistry I and Organic Chemistry I Laboratory  
  **Credit Hours**: 5
- **STA 1403**  
  Probability and Statistics for the Biosciences  
  **Credit Hours**: 3

## Third Year

#### Fall
- **BIO 3413**  
  General Physiology  
  **Credit Hours**: 3
- **BIO 3503**  
  Sophomore Research Initiative Peer Mentor  
  **Credit Hours**: 2
- **COM 2113**  
  Public Speaking  
  **Credit Hours**: 3

#### Spring
- **BIO 3813**  
  Cell Biology  
  **Credit Hours**: 3
- **BIO 3053**  
  Sophomore Research Experience  
  **Credit Hours**: 3
- **CHE 3643**  
  Organic Chemistry II  
  **Credit Hours**: 3

## Fourth Year

### Fall
- **BIO 1173**  
  Introduction to Computational Biology  
  **Credit Hours**: 3
- **BIO 3513**  
  Biochemistry  
  **Credit Hours**: 3
- **BIO 4912**  
  Independent Study  
  **Credit Hours**: 2

## B.S. in Biology – Recommended Four-Year Academic Plan for Concentration in Premedical Sciences.

This course sequence guide is designed to assist students in completing their UTSA B.S. Degree in Biology with a Premedical Sciences Concentration. This course sequence is only a guide and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans. Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. Students may choose to take courses during Summer terms to reduce course loads during long semesters.
### Second Year

**Fall**
- **BIO 2313** Genetics 3
- **BIO 2362** or **BIO 2953** Molecular Genetics Laboratory (SBRI students should take BIO 2953) or Special Topics in Biology 2-3
- **CHE 2603 & CHE 2612** Organic Chemistry I and Organic Chemistry I Laboratory 5
- **STA 1403** Probability and Statistics for the Biosciences 3
- **ENG 2413** Technical Writing (core) 3

**Credit Hours** 16

**Spring**
- **BIO 2992** Medical Terminology 2
- **BIO 3413** General Physiology 3
- **BIO 3813** Cell Biology 3
- **CHE 3643** Organic Chemistry II 3
- **PSY 1013** Introduction to Psychology (core) 3

**Credit Hours** 16

### Third Year

**Fall**
- **BIO 3013** Introduction to Clinical Medicine and Pathology 3
- **BIO 3643 & BIO 3642** Advanced Physiology I and Clinical Anatomy Laboratory I 5
- Select one of the following sequences: 4
  - **PHY 1603 & PHY 1611** Algebra-based Physics I and Algebra-based Physics I Laboratory
  - **PHY 1943 & PHY 1951** Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory
- **American History (core)** 3

**Credit Hours** 14

**Spring**
- **BIO 3173** Introduction to Computational Biology 3
- **BIO 3433** Neurobiology 3
- **COM 2113** Public Speaking 3
- **Government-Political Science (core)** 3
- **Language, Philosophy, & Culture (core)** 3

**Credit Hours** 15

**Total Credit Hours** 15

### Fourth Year

**Fall**
- **BIO 3513** Biochemistry 3
- **BIO 3362** or **BIO 3953** Molecular Biochemistry Laboratory (SBRI students should take BIO 2953) or Special Topics in Biology 2
- **BIO 3663** Human Embryology 3
- **BIO 3713** Microbiology 3
- **American History (core)** 3
- **Creative Arts (core)** 3

**Credit Hours** 17

**Spring**
- **BIO 1173** Introduction to Computational Biology 3
- **BIO 3433** Neurobiology 3
- **COM 2113** Public Speaking 3
- **Government-Political Science (core)** 3
- **Language, Philosophy, & Culture (core)** 3

**Credit Hours** 15

**Total Credit Hours** 120

**Note:** Some courses are only offered once a year; Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.

### B.S. in Biology – Recommended Four-Year Academic Plan for Concentration in Grade 7-12 Biology with Teaching Certification

This course sequence guide is designed to assist students in completing their UTSA undergraduate B.S. Degree in Biology with a Grade 7-12 Biology Teaching Certification. This course sequence is only a guide and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans. Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. Note: Some courses are only offered once a year, Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.

### First Year

**Fall**
- **AIS 1203** Academic Inquiry and Scholarship (core) 3
- **BIO 1203 & BIO 1201** Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors (core and major) 4
- **CHE 1103 & CHE 1111** General Chemistry I and General Chemistry I Laboratory 4
- **UTE 1111** Introduction to STEM Teaching Step 1 1
- **WRC 1013** Freshman Composition I (core) 3

**Credit Hours** 15

**Spring**
- **BIO 1223 & BIO 1221** Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors (core and major) 4
- **CHE 1113** General Chemistry II 3
- **CHE 1131** General Chemistry II Laboratory 1
- **UTE 1122** Introduction to STEM Teaching Step 2 2

**Credit Hours** 15

**Total Credit Hours** 120
**Department of Integrative Biology**

<table>
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<tr>
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<th>Course Title</th>
<th>Credits</th>
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<td>Calculus for the Biosciences (core)</td>
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<tr>
<td>or</td>
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<tr>
<td>STA 1053</td>
<td>Basic Statistics (core)</td>
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**Credit Hours** 16

**Summer**

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<tr>
<td>Government-Political Science (core)</td>
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**Second Year**

**Fall**

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<td>PHY 1603</td>
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<td>or</td>
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**Credit Hours** 17

**Spring**

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<td>PHY 1623</td>
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<td>or</td>
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<td>PHY 1963</td>
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<td>UTE 3213</td>
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<tr>
<td>Social &amp; Behavioral Sciences (core)</td>
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**Credit Hours** 14

**Summer**

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<th>Course Title</th>
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<td>Government-Political Science (core)</td>
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**Third Year**

**Fall**

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<td>BIO 3713</td>
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<td>UTE 3023</td>
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**Credit Hours** 14

**Spring**

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**Fourth Year**

**Fall**

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<td>BIO 3813</td>
<td>3</td>
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<td>SPE 3603</td>
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**Credit Hours** 15

**Spring**

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<tbody>
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<td>UTE 4646</td>
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**Credit Hours** 6

**Total Credit Hours** 124

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**Note:** Some courses are only offered once a year; Fall or Spring. Check with the Department of Integrative Biology for scheduling of courses.

**Bachelor of Science Degree in Environmental Science**

The Bachelor of Science (B.S.) Degree in Environmental Science is designed for students interested in studying environmental problems from a scientific perspective. The major prepares students to deal with issues arising from the impact of human interaction on natural systems. The program of study is structured around a comprehensive curriculum that includes botany, zoology, geology, environmental statistics, geographical information systems, environmental law, soils, watershed processes, global change, fate and transport of chemicals, and environmental assessment. Students may choose to specialize further in one of four focus areas: 1) conservation and restoration ecology, 2) environmental management, 3) natural resources and wildlife management, and 4) aquatic sciences. Students will gain hands-on experience with many of the instrumental techniques used in environmental analysis and have the opportunity to engage in teamwork for field studies, excursions, and laboratory studies. There is a strong emphasis on producing graduates with well-developed oral and written communication skills who are capable of complex problem-solving.

Some of the careers a B. S. degree in Environmental Science will prepare students for are environmental biologist, environmental chemist, environmental consultant, environmental engineer, environmental geologist, environmental health and safety officer, environmental health officer, environmental lawyer, environmental manager, environmental science teacher, environmental scientist, environmental specialist, environmental technician, geographer, microbiologist, water quality scientist, or wildlife biologist.

The minimum number of semester credit hours required for the B.S. degree in Environmental Science, including the Core Curriculum requirements, is 120.

Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level.
All major and support work courses and the required prerequisites must be completed with a grade of "C-" or better.

Program Outcomes
Graduates of the B.S. Degree in Environmental Science program will be able to:

• Explain foundational concepts in environmental science, including plant and animal biology, ecosystem ecology, toxicology, conservation biology, environmental policy, geology, climate change, and human impacts on the environment.
• Evaluate issues related to the environment using an interdisciplinary and multidisciplinary course of study.
• Apply the process of scientific inquiry.
• Use appropriate field and/or laboratory methods to collect quality data.
• Use appropriate quantitative and qualitative methods to evaluate environmental data.
• Demonstrate critical thinking skills in relation to environmental issues.
• Demonstrate ability to work effectively in a team with others from diverse disciplines and backgrounds.
• Effectively communicate scientific information, and the relationship between science and society, to a diverse audience through oral, written, and visual means.

Core Curriculum Requirements (42 semester credit hours)

Students seeking the B.S. Degree in Environmental Science must fulfill University Core Curriculum requirements in the same manner as other students. If courses are taken to satisfy both degree requirements and Core Curriculum requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegeregulations/degreerequirements/corecurriculumcomponentarearequirements/)
First Year Experience Requirement 3
Communication 6
Mathematics 3
Life and Physical Sciences 6
Language, Philosophy and Culture 3
Creative Arts 3
American History 6
Government-Political Science 6
Social and Behavioral Sciences 3
Component Area Option 3
Total Credit Hours 42

Gateway Courses
Students pursuing the B.S. Degree in Environmental Science must complete each of the following Gateway Courses with a grade of "C-" or better in no more than two attempts. A student who is unable to complete these courses within two attempts, including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change his or her major.

Degree Requirements

A. Required environmental science courses (54 hours of which 6 are in the core)
Must be completed with a grade of "C-" or better

<table>
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<th>Credit Hours</th>
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<td>ES 1123 &amp; ES 1121</td>
<td>Environmental Zoology  and Environmental Zoology Laboratory</td>
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<td>ES 1213 &amp; ES 1211</td>
<td>Environmental Geology  and Environmental Geology Laboratory</td>
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<td>ES 1314</td>
<td>Environmental Statistics</td>
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<td>ES 2013 &amp; ES 2021</td>
<td>Introduction to Environmental Science I and Introduction to Environmental Science I Laboratory</td>
<td>6</td>
</tr>
<tr>
<td>ES 2023 &amp; ES 2031</td>
<td>Introduction to Environmental Science II and Introduction to Environmental Science II Laboratory</td>
<td>6</td>
</tr>
<tr>
<td>ES 2113</td>
<td>Fundamentals of Geographic Information Systems (GIS)</td>
<td>3</td>
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<tr>
<td>ES 3033 &amp; ES 3042</td>
<td>Environmental Ecology and Environmental Ecology Laboratory</td>
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<tr>
<td>ES 3123 &amp; ES 3121</td>
<td>Introduction to Soils and Introduction to Soils Laboratory</td>
<td>6</td>
</tr>
<tr>
<td>ES 3143 &amp; ES 3141</td>
<td>Watershed Processes and Watershed Processes Laboratory</td>
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<tr>
<td>ES 3203</td>
<td>Environmental Law</td>
<td>3</td>
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<tr>
<td>ES 4103</td>
<td>Global Change</td>
<td>3</td>
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<tr>
<td>ES 4203</td>
<td>Environmental Assessment</td>
<td>3</td>
</tr>
<tr>
<td>ES 4212</td>
<td>Senior Seminar</td>
<td>3</td>
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<tr>
<td>ES 4253</td>
<td>Sources, Fate, and Transport of Chemicals in the Environment</td>
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B. Required support courses (15 hours of which 6 are in the core) 15
Must be completed with a grade of "C-" or better

<table>
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<td>3</td>
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<tr>
<td>CHE 1093</td>
<td>Introduction to Molecular Transformations</td>
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</tr>
<tr>
<td>COM 2113</td>
<td>Public Speaking</td>
<td>3</td>
</tr>
<tr>
<td>ENG 2413</td>
<td>Technical Writing</td>
<td>3</td>
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<tr>
<td>MAT 1093</td>
<td>Precalculus</td>
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</table>

C. Area of Study courses 21
Upper-division environmental science courses completed with a grade of "C-" or better

10 | 08/21/23
Twenty-one (21) semester credit hours of additional environmental science courses are required of which 15 hours must be upper-division. While the degree is a general degree in environmental science, four areas of study have been identified within the B.S. degree program for students interested in conservation and restoration ecology, environmental management, natural resources and wildlife management, or aquatic sciences. Depending on their area of interest, students may select courses from the following areas of study:

**Conservation and Restoration Ecology**

Required Courses:
- ES 4213 Conservation Biology
- ES 4233 Restoration Ecology

Select five courses from the following:
- ES 3053 Environmental Remediation
- ES 3073 Environmental Rhetoric and Technical Communication
- ES 3103 Environmental Microbiology
- ES 3113 Ichthyology
- ES 3133 Oceanography
- ES 3153 Environmental Chemistry
- ES 3163 Ornithology
- ES 3173 Mammalogy
- ES 3183 Entomology
- ES 3193 Herpetology
- ES 3213 Biology of Flowering Plants
- ES 3223 Woody Plants
- ES 3233 Survey of Insects
- ES 3253 R Coding in Environmental Science and Ecology
- ES 3303 Sustainable Development
- ES 3953 Topics in Environmental Science
- ES 4023 Aquatic Ecology
- ES 4113 Field Biology
- ES 4123 Desert Biology
- ES 4133 Natural Resource Policy and Administration
- ES 4153 Introduction to Sustainability
- ES 4163 Renewable Energy
- ES 4173 Waste Water Treatment
- ES 4233 River Ecosystems
- ES 4283 Plant-Soil-Microbe Interactions
- ES 4913 Independent Study
- ES 4953 Special Studies in Environmental Science
- ES 4963 Internship

**Environmental Management**

Required Courses:
- ES 3053 Environmental Remediation
- ES 3103 Environmental Microbiology
- ES 4183 Environmental Toxicology
- ES 4503 Introduction to Environmental Risk Assessment
- ES 4513 Advanced Environmental Risk Assessment

Select two courses from the following:
- ES 3073 Environmental Rhetoric and Technical Communication
- ES 3113 Ichthyology
- ES 3133 Oceanography
- ES 3153 Environmental Chemistry
- ES 3253 R Coding in Environmental Science and Ecology
- ES 3303 Sustainable Development
- ES 3953 Topics in Environmental Science
- ES 4023 Aquatic Ecology
- ES 4153 Introduction to Sustainability
- ES 4163 Renewable Energy
- ES 4173 Waste Water Treatment
- ES 4243 Wildlife Management
- ES 4263 River Ecosystems
- ES 4283 Plant-Soil-Microbe Interactions
- ES 4913 Independent Study
- ES 4953 Special Studies in Environmental Science
- ES 4963 Internship

**Natural Resources and Wildlife Management**

Required courses:
- ES 4133 Natural Resource Policy and Administration
- ES 4243 Wildlife Management

Select five courses from the following:
- ES 3053 Environmental Remediation
- ES 3073 Environmental Rhetoric and Technical Communication
- ES 3103 Environmental Microbiology
- ES 4113 Field Biology
- ES 4123 Desert Biology
- ES 4133 Natural Resource Policy and Administration
- ES 4153 Introduction to Sustainability
- ES 4163 Renewable Energy
- ES 4173 Waste Water Treatment
- ES 4233 River Ecosystems
- ES 4283 Plant-Soil-Microbe Interactions
- ES 4913 Independent Study
- ES 4953 Special Studies in Environmental Science
- ES 4963 Internship

- ES 3253 R Coding in Environmental Science and Ecology
- ES 3303 Sustainable Development
- ES 3953 Topics in Environmental Science
- ES 4023 Aquatic Ecology
- ES 4113 Field Biology
- ES 4123 Desert Biology
**Course Sequence Guide for B.S. Degree in Environmental Science**

This course sequence guide is designed to assist students in completing their UTSA B.S. Degree in Environmental Science. *This is merely a guide and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans. Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. Students may choose to take courses during Summer terms to reduce course loads during long semesters.*

### B.S. in Environmental Science – Recommended Four-Year Academic Plan

#### First Year

**Fall**
- **AIS 1203**: Academic Inquiry and Scholarship (core) 3
- **ES 1123**: Environmental Zoology (core and major) 3
- **ES 1121**: Environmental Zoology Laboratory 1
- **MAT 1093**: Precalculus (core) 3
- **WRC 1013**: Freshman Composition I (core) 3

**Credit Hours** 16

**Spring**
- **COM 2113**: Public Speaking (core) 3
- **ES 1113**: Environmental Botany (core) 3
- **ES 1111**: Environmental Botany Laboratory 1
- **ES 1314**: Environmental Statistics 4
- **WRC 1023**: Freshman Composition II (core) 3

**Credit Hours** 16

#### Second Year

**Fall**
- **ES 2013**: Introduction to Environmental Science I 3
- **ES 2021**: Introduction to Environmental Science I Laboratory 1
- **ES 2113**: Fundamentals of Geographic Information Systems (GIS) 3
- **CHE 1083**: Introduction to the Molecular Structure of Matter 3
- **POL 1013**: Introduction to American Politics (core) 3

**Credit Hours** 16

**Spring**
- **ES 2023**: Introduction to Environmental Science II 3

**Total Credit Hours** 90
historical, ethical, spiritual, economic, and political dimensions of complex environmental issues. Solving these problems requires an integration of disciplines to provide the understanding needed to address complex environmental issues.

The field includes study in basic principles of ecology and environmental science, as well as associated subjects such as ethics, geography, policy, politics, law, economics, philosophy, environmental sociology, environmental justice, urban planning, pollution control, and natural resource management.

Some of the careers a B.A. degree in Environmental Studies will prepare students for are environmental consultant, environmental educator, environmental lobbyist, environmental planner, environmental attorney, natural resource specialist, outdoor education teacher, park naturalist, park ranger, resource economist, policy analyst, public relations specialist, sustainability specialist, and urban and regional planner.

The minimum number of semester credit hours required for the B.A. degree in Environmental Studies, including the Core Curriculum requirements, is 120.

Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work courses and the required prerequisites must be completed with a grade of “C-” or better.

**Program Outcomes**

Graduates of the B.A. Degree in Environmental Studies program will be able to:

- Explain foundational concepts in the natural sciences, social sciences, and humanities as applied to environmental issues, including human-environment interactions, monitoring the health of environmental systems, environmental policy & law, urbanization and impacts of built environments, sustainability, and socio-cultural influences on human-environment relationships.
- Apply systems thinking and multidisciplinary methodologies to address environmental problems.
- Apply the process of scientific inquiry.
- Demonstrate critical thinking skills in relation to environmental issues.
- Use appropriate field and/or laboratory methods to collect quality data.
- Use appropriate quantitative and qualitative methods to evaluate environmental data.
- Demonstrate ability to work effectively in a team with others from diverse disciplines and backgrounds.
- Effectively communicate scientific information, and the relationship between science and society, to a diverse audience through oral, written, and visual means.

**Bachelor of Arts Degree in Environmental Studies**

The Bachelor of Arts (B.A.) degree in Environmental Studies is designed to provide students with a multidisciplinary educational approach regarding environmental issues and foster system-thinking skills. The degree reinforces the crucial role of interdisciplinary approaches in environmental problem solving by emphasizing the sociocultural, historical, ethical, spiritual, economic, and political dimensions of complex environmental issues. Solving these problems requires an integration of disciplines to provide the understanding needed to address complex environmental issues.

The field includes study in basic principles of ecology and environmental science, as well as associated subjects such as ethics, geography, policy, politics, law, economics, philosophy, environmental sociology, environmental justice, urban planning, pollution control, and natural resource management.

Some of the careers a B.A. degree in Environmental Studies will prepare students for are environmental consultant, environmental educator, environmental lobbyist, environmental planner, environmental attorney, natural resource specialist, outdoor education teacher, park naturalist, park ranger, resource economist, policy analyst, public relations specialist, sustainability specialist, and urban and regional planner.

The minimum number of semester credit hours required for the B.A. degree in Environmental Studies, including the Core Curriculum requirements, is 120.

Thirty-nine of the total semester credit hours required for the degree must be at the upper-division level.

All major and support work courses and the required prerequisites must be completed with a grade of “C-” or better.

**Program Outcomes**

Graduates of the B.A. Degree in Environmental Studies program will be able to:

- Explain foundational concepts in the natural sciences, social sciences, and humanities as applied to environmental issues, including human-environment interactions, monitoring the health of environmental systems, environmental policy & law, urbanization and impacts of built environments, sustainability, and socio-cultural influences on human-environment relationships.
- Apply systems thinking and multidisciplinary methodologies to address environmental problems.
- Apply the process of scientific inquiry.
- Demonstrate critical thinking skills in relation to environmental issues.
- Use appropriate field and/or laboratory methods to collect quality data.
- Use appropriate quantitative and qualitative methods to evaluate environmental data.
- Demonstrate ability to work effectively in a team with others from diverse disciplines and backgrounds.
- Effectively communicate scientific information, and the relationship between science and society, to a diverse audience through oral, written, and visual means.

**Core Curriculum Requirements (42 semester credit hours)**

Students seeking the B.A. Degree in Environmental Studies must fulfill University Core Curriculum requirements in the same manner as other students. If courses are taken to satisfy both degree requirements and Core Curriculum requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

---

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<tbody>
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<tr>
<td>ES 1213</td>
<td>Environmental Geology</td>
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<td>ES 1211</td>
<td>Environmental Geology Laboratory</td>
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<tr>
<td>CHE 1093</td>
<td>Introduction to Molecular Transformations</td>
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<td>Technical Writing</td>
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**Third Year**

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<td>Introduction to Soils</td>
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<td>ES 3121</td>
<td>Introduction to Soils Laboratory</td>
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<td>ES 3033</td>
<td>Environmental Ecology</td>
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<tr>
<td>ES 3042</td>
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<td>POL 1133</td>
<td>Texas Politics and Society (core)</td>
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<tr>
<td>ES 3143</td>
<td>Watershed Processes</td>
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<td>ES 3141</td>
<td>Watershed Processes Laboratory</td>
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<tr>
<td>ES 4253</td>
<td>Sources, Fate, and Transport of Chemicals in the Environment</td>
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<td>ES Area of Study Required</td>
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<td>American History (core)</td>
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**Fourth Year**

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<td>ES 4103</td>
<td>Global Change (major)</td>
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<tr>
<td>ES 3203</td>
<td>Environmental Law (major)</td>
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</tr>
<tr>
<td>ES Area of Study Elective (major)</td>
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<td>3</td>
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<tr>
<td>ES Area of Study Elective (major)</td>
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<td>3</td>
</tr>
<tr>
<td>Language, Philosophy &amp; Culture (core)</td>
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**Spring**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>ES 4203</td>
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<td>ES 4212</td>
<td>Senior Seminar</td>
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<td>ES Area of Study Elective</td>
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<tr>
<td>ES Area of Study Elective</td>
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<td>3</td>
</tr>
<tr>
<td>Social and Behavioral Science (core)</td>
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**Total Credit Hours**

120

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<td>Communication</td>
<td>6</td>
</tr>
<tr>
<td>Mathematics</td>
<td>3</td>
</tr>
<tr>
<td>Life and Physical Sciences</td>
<td>6</td>
</tr>
<tr>
<td>Language, Philosophy and Culture</td>
<td>3</td>
</tr>
<tr>
<td>Creative Arts</td>
<td>3</td>
</tr>
<tr>
<td>American History</td>
<td>6</td>
</tr>
<tr>
<td>Government-Political Science</td>
<td>6</td>
</tr>
<tr>
<td>Social and Behavioral Sciences</td>
<td>3</td>
</tr>
<tr>
<td>Component Area Option</td>
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<tr>
<td>Total Credit Hours</td>
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### Degree Requirements

<table>
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<th>Credit Hours</th>
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<tbody>
<tr>
<td></td>
<td>A. Required courses (72 hours of which 12 are in the core) 72</td>
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</tr>
<tr>
<td></td>
<td>Must be completed with a grade of &quot;C-&quot; or better</td>
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<tr>
<td>ANT 2053</td>
<td>Introduction to Cultural Anthropology</td>
<td></td>
</tr>
<tr>
<td>CHE 1083</td>
<td>Introduction to the Molecular Structure of Matter</td>
<td></td>
</tr>
<tr>
<td>ECO 2003</td>
<td>Economic Principles and Issues</td>
<td></td>
</tr>
<tr>
<td>ENG 2413</td>
<td>Technical Writing</td>
<td></td>
</tr>
<tr>
<td>ES 1003</td>
<td>Survey Topics in Environmental Studies</td>
<td></td>
</tr>
<tr>
<td>ES 1113</td>
<td>Environmental Botany</td>
<td></td>
</tr>
<tr>
<td>ES 1123</td>
<td>Environmental Zoology</td>
<td></td>
</tr>
<tr>
<td>ES 1213</td>
<td>Environmental Geology</td>
<td></td>
</tr>
<tr>
<td>ES 1314</td>
<td>Environmental Statistics</td>
<td></td>
</tr>
<tr>
<td>ES 2013</td>
<td>Introduction to Environmental Science I and Introduction to Environmental Science I Laboratory</td>
<td></td>
</tr>
<tr>
<td>ES 2023</td>
<td>Introduction to Environmental Science II and Introduction to Environmental Science II Laboratory</td>
<td></td>
</tr>
<tr>
<td>ES 2113</td>
<td>Fundamentals of Geographic Information Systems (GIS)</td>
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<tr>
<td>COM 2113</td>
<td>Public Speaking</td>
<td></td>
</tr>
<tr>
<td>ENG 3383</td>
<td>Writing in Public and Professional Contexts</td>
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</tr>
<tr>
<td>ES 3203</td>
<td>Environmental Law</td>
<td></td>
</tr>
<tr>
<td>ES 4133</td>
<td>Natural Resource Policy and Administration</td>
<td></td>
</tr>
<tr>
<td>ES 4153</td>
<td>Introduction to Sustainability</td>
<td></td>
</tr>
<tr>
<td>ES 4163</td>
<td>Renewable Energy</td>
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<tr>
<td>ES 4203</td>
<td>Environmental Assessment</td>
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<tr>
<td>GES 3753</td>
<td>Climate Change</td>
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<tr>
<td>MS 4333</td>
<td>Project Management</td>
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<tr>
<td>PAD 3043</td>
<td>Public and Nonprofit Financial Management</td>
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</tr>
<tr>
<td>PAD 3163</td>
<td>Quantitative Analysis for Public Administration and Policy</td>
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<tr>
<td></td>
<td>B. Choose four (4) of the following courses 12</td>
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<tr>
<td></td>
<td>Twelve (12) semester credit hours of additional elective hours from the following list:</td>
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<tr>
<td></td>
<td>C. Choose two of the following courses 6</td>
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<tr>
<td>ES 4953</td>
<td>Special Studies in Environmental Science</td>
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</tr>
<tr>
<td>ES 4963</td>
<td>Internship</td>
<td></td>
</tr>
<tr>
<td>ES 4113</td>
<td>Field Biology</td>
<td></td>
</tr>
<tr>
<td>ES 4123</td>
<td>Desert Biology</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Credit Hours 90</td>
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</table>

### Course Sequence Guide for B.A. Degree in Environmental Studies

This course sequence guide is designed to assist students in completing their UTSA B.A. Degree in Environmental Studies. *This is merely a guide and students must satisfy other requirements of this catalog and meet with their academic advisor for individualized degree plans.* Progress within this guide depends upon such factors as course availability, individual student academic preparation, student time management, work obligations, and individual financial considerations. Students may choose to take courses during Summer terms to reduce course loads during long semesters.

#### B.A. in Environmental Studies – Recommended Four-Year Academic Plan

<table>
<thead>
<tr>
<th>Year</th>
<th>Fall</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>AIS 1203 Academic Inquiry and Scholarship (core) 3</td>
<td></td>
</tr>
</tbody>
</table>
Bachelor of Science Degree in Multidisciplinary Science with Teacher Certification in Grades 7-12

The Bachelor of Science (B.S.) Degree in Multidisciplinary Science (MDS.) is designed for future secondary science teachers and gives students broad training across the sciences. The MDS degree offers a composite science certification track through the College of Education and Human Development (COEHD) and in conjunction with UTeachSA, which is designed to prepare students for a career in teaching secondary school science. Students seeking teacher certification should contact the Interdisciplinary Education Advising and Certification Center as early in their educational program as possible, but no later than their fourth semester of study, for information about certificate requirements and admission procedures. Undergraduates seeking elementary teacher certification must complete the Interdisciplinary Studies degree.

Some of the careers a B.S. degree in Multidisciplinary Science will prepare students for are teaching various science courses in grades 7-12, including biology, chemistry, physics, integrated physics and chemistry, astronomy, Earth and space science, environmental systems, aquatic science, anatomy and physiology, medical microbiology, pathophysiology, and scientific research and design.

The minimum number of semester credit hours required for this degree, including the Core Curriculum requirements, is 120 hours.

Thirty-nine of the total semester credit hours for the degree must be at the upper-division level. All major and support work must be completed with a grade of "C-" or better.

All candidates seeking this degree must fulfill the Core Curriculum requirements and the degree requirements, which are listed below.
Program Outcomes
Graduates of the B.S. Degree in Multidisciplinary Sciences program will be able to:

- Explain foundational concepts in the sciences, specifically:
  - physics and astronomy
  - chemistry
  - biology including cell structure, biological processes, genetics, and evolution
  - environmental science including biodiversity
  - geology
- Develop skills in teaching, learning, and assessment.
- Apply the process of scientific inquiry.
- Demonstrate critical thinking skills in relation to scientific issues.
- Use appropriate field and/or laboratory methods to collect quality data.
- Use appropriate quantitative and qualitative methods to evaluate scientific data.
- Demonstrate ability to work effectively in a team with others from diverse disciplines and backgrounds.
- Effectively communicate scientific information, and the relationship between science and society, to a diverse audience through oral, written, and visual means.

Criminal Background Check
Teacher preparation programs at UTSA require fieldwork in public schools. This requires that a student be able to pass a criminal background check conducted by the school districts. It is the responsibility of the student to determine if their criminal history will present a problem before applying for admission to the teacher preparation program. Students with a problematic criminal history will encounter difficulty in completing any fieldwork requirements and may not be able to complete the program.

Core Curriculum Requirements (42 semester credit hours)
Students seeking the B.S. Degree in Multidisciplinary Science must fulfill University Core Curriculum requirements in the same manner as other students. If courses are taken to satisfy both degree requirements and Core Curriculum requirements, then students may need to take additional courses to meet the minimum number of semester credit hours required for this degree.

Core Curriculum Component Area Requirements (http://catalog.utsa.edu/undergraduate/bachelorsdegreeregulations/degreerequirements/corecurriculumcomponentarearequirements/)

<table>
<thead>
<tr>
<th>First Year Experience Requirement</th>
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<tbody>
<tr>
<td>Communication</td>
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<tr>
<td>Mathematics</td>
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<tr>
<td>Life and Physical Sciences</td>
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<td>Language, Philosophy and Culture</td>
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<td>Creative Arts</td>
<td>3</td>
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<tr>
<td>American History</td>
<td>6</td>
</tr>
<tr>
<td>Government-Political Science</td>
<td>6</td>
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<tr>
<td>Social and Behavioral Sciences</td>
<td>3</td>
</tr>
<tr>
<td>Component Area Option</td>
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</table>

Total Credit Hours 42

Gateway Course
Students pursuing the B.S. Degree in Multidisciplinary Science must complete the following Gateway Course with a grade of "C-" or better in no more than two attempts. A student who is unable to complete the course within two attempts, including dropping a course with a grade of "W" or taking an equivalent course at another institution, will be required to change his or her major.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
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<tr>
<td>BIO 1203 &amp; BIO 1201</td>
<td>Biosciences I for Science Majors and Biosciences I Laboratory for Science Majors</td>
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</tr>
<tr>
<td>BIO 1223 &amp; BIO 1221</td>
<td>Biosciences II for Science Majors and Biosciences II Laboratory for Science Majors</td>
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<tr>
<td>BIO 2313</td>
<td>Genetics</td>
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<tr>
<td>BIO 3413</td>
<td>General Physiology</td>
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<tr>
<td>CHE 1103 &amp; CHE 1121</td>
<td>General Chemistry I and General Chemistry I Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>CHE 1113 &amp; CHE 1131</td>
<td>General Chemistry II and General Chemistry II Laboratory</td>
<td>4</td>
</tr>
<tr>
<td>ES 2013 &amp; ES 2021</td>
<td>Introduction to Environmental Science I and Introduction to Environmental Science I Laboratory</td>
<td>4</td>
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<tr>
<td>ES 2023 &amp; ES 2031</td>
<td>Introduction to Environmental Science II and Introduction to Environmental Science II Laboratory</td>
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<td>ES 3033</td>
<td>Environmental Ecology</td>
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<tr>
<td>ES 3133</td>
<td>Oceanography</td>
<td>3</td>
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<td>GEO 1103 &amp; GEO 1111</td>
<td>Physical Geology and Physical Geology Laboratory</td>
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<tr>
<td>MAT 1193</td>
<td>Calculus for the Biosciences</td>
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<tr>
<td>or STA 1053</td>
<td>Basic Statistics</td>
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<tr>
<td>ES 4023</td>
<td>Aquatic Ecology</td>
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Select one of the following options:

Option 1

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<td>Algebra-based Physics I and Algebra-based Physics I Laboratory</td>
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<tr>
<td>PHY 1623 &amp; PHY 1631</td>
<td>Algebra-based Physics II and Algebra-based Physics II Laboratory</td>
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Option 2

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<td>Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory</td>
<td>4</td>
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<tr>
<td>PHY 1963 &amp; PHY 1971</td>
<td>Physics for Scientists and Engineers II and Physics for Scientists and Engineers II Laboratory</td>
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## Certification Requirements (Composite Science Emphasis)

Students seeking a B.S. Degree in Multidisciplinary Sciences (MDS) as preparation for a graduate degree in science should follow as closely as possible the degree requirements of their chosen science as those courses are most likely to be required by graduate schools in that field. It is possible through careful planning to achieve a double major in M.D.S. and another science. All MDS students should create a four-year plan through an undergraduate academic advisor as early as possible in their course of study, and continue to check in on a course-by-course basis should those plans change.

### B.S. in Multidisciplinary Science with Grades 7–12 Teaching Certification – Recommended Four-Year Academic Plan

#### First Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credit Hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall</td>
<td>Credit Hours</td>
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<tr>
<td>AIS 1203 Academic Inquiry and Scholarship</td>
<td>3</td>
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<tr>
<td>BIO 1203 &amp; BIO 1201 Biosciences I for Science Majors</td>
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<td>WRC 1013 Freshman Composition I (core)</td>
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<tr>
<td>UTE 1111 Introduction to STEM Teaching Step 1</td>
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<td>American History (core)</td>
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#### Second Year

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<tbody>
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</tr>
<tr>
<td>CHE 1103 General Chemistry I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHE 1121 General Chemistry I Laboratory</td>
<td></td>
</tr>
<tr>
<td>ES 2013 Introduction to Environmental Science I</td>
<td>4</td>
</tr>
<tr>
<td>&amp; ES 2021 Introduction to Environmental Science I Laboratory</td>
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<tr>
<td>UTE 3203 Knowing and Learning in Mathematics and Science</td>
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</tr>
<tr>
<td>Creative Arts (core)</td>
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#### Third Year

<table>
<thead>
<tr>
<th>Fall</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>Fall</td>
<td>Credit Hours</td>
</tr>
<tr>
<td>BIO 2313 Genetics</td>
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<tr>
<td>ES 2023 Introduction to Environmental Science II and ES 2021 Introduction to Environmental Science I Laboratory</td>
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<td>UTE 3023 Perspectives on Science and Mathematics</td>
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<td>Select one of the following:</td>
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<tr>
<td>PHY 1603 &amp; PHY 1611 Algebra-based Physics I and Algebra-based Physics I Laboratory</td>
<td></td>
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<tr>
<td>or</td>
<td></td>
</tr>
<tr>
<td>PHY 1943 &amp; PHY 1951 Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory</td>
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#### Summer

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<tr>
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</tr>
<tr>
<td>PSY 1013 Introduction to Psychology (core)</td>
<td>3</td>
</tr>
<tr>
<td>Government-Political Science (core)</td>
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<tr>
<td>Language, Philosophy &amp; Culture (core)</td>
<td>3</td>
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<table>
<thead>
<tr>
<th>Courses</th>
<th>Credit Hours</th>
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<tbody>
<tr>
<td>CHE 1113 General Chemistry II</td>
<td>4</td>
</tr>
<tr>
<td>&amp; CHE 1131 General Chemistry II Laboratory</td>
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</tr>
<tr>
<td>GEO 1103 Physical Geology</td>
<td>4</td>
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<tr>
<td>&amp; GEO 1111 Physical Geology Laboratory</td>
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</tr>
<tr>
<td>UTE 3213 Classroom Interactions</td>
<td>3</td>
</tr>
<tr>
<td>Government-Political Science (core)</td>
<td>3</td>
</tr>
</tbody>
</table>

### Credit Hours

- Total Credit Hours: 87
- Second Year Credit Hours: 12
- Third Year Credit Hours: 14
- Summer Credit Hours: 3

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### Education Courses

- ESL 3083 Second Language Teaching and Learning for Grades 7-12
- LTED 3773 Reading and Writing Across the Disciplines-Grades 7–12
- SPE 3603 Introduction to Special Education
- UTE 1111 Introduction to STEM Teaching Step 1
- UTE 1122 Introduction to STEM Teaching Step 2
- UTE 3023 Perspectives on Science and Mathematics
- UTE 3203 Knowing and Learning in Mathematics and Science
- UTE 3213 Classroom Interactions
- UTE 4203 Project-Based Instruction
- UTE 4646 Clinical Teaching

### Summer Courses

- CS 1173 Data Analysis and Visualization (core) 3
- PSY 1013 Introduction to Psychology (core) 3
- Government-Political Science (core) 3
- Language, Philosophy & Culture (core) 3

- CHE 1103 General Chemistry I 4
- CHE 1121 General Chemistry I Laboratory
- ES 2013 Introduction to Environmental Science I 4
- ES 2021 Introduction to Environmental Science I Laboratory
- UTE 3203 Knowing and Learning in Mathematics and Science 3
- Creative Arts (core) 3

### Spring Courses

- CHE 1113 General Chemistry II 4
- CHE 1131 General Chemistry II Laboratory
- GEO 1103 Physical Geology 4
- GEO 1111 Physical Geology Laboratory
- UTE 3213 Classroom Interactions 3
- Government-Political Science (core) 3

### Third Year Courses

- BIO 2313 Genetics 3
- ES 2023 Introduction to Environmental Science II and ES 2021 Introduction to Environmental Science I Laboratory 4
- UTE 3023 Perspectives on Science and Mathematics 3
- Select one of the following: 4
- PHY 1603 & PHY 1611 Algebra-based Physics I and Algebra-based Physics I Laboratory
- PHY 1943 & PHY 1951 Physics for Scientists and Engineers I and Physics for Scientists and Engineers I Laboratory

### Summer Courses

- ES 3033 Environmental Ecology 3
- ES 3133 Oceanography 3
- SPE 3603 Introduction to Special Education 3
- UTE 4203 Project-Based Instruction 3
- Select one of the following: 4
- PHY 1623 & PHY 1631 Algebra-based Physics II and Algebra-based Physics II Laboratory
Minor in Environmental Science

The Minor in Environmental Science is open to all majors in the University. To declare a Minor in Environmental Science or obtain advice, students should consult with their academic advisor. All students pursuing the Minor in Environmental Science must complete 22 semester credit hours of Environmental Science courses including a minimum of 6 hours of upper-division courses. All coursework must be completed with a grade of "C-" or better.

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Credit Hours</th>
</tr>
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<tbody>
<tr>
<td>A.</td>
<td>16 semester credit hours of required courses:</td>
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<tr>
<td>ES 2013</td>
<td>Introduction to Environmental Science I</td>
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<tr>
<td>ES 2021</td>
<td>Introduction to Environmental Science I Laboratory</td>
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<tr>
<td>ES 2023</td>
<td>Introduction to Environmental Science II</td>
<td></td>
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<td>ES 2031</td>
<td>Introduction to Environmental Science II Laboratory</td>
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<tr>
<td>ES 3033</td>
<td>Environmental Ecology</td>
<td></td>
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<tr>
<td>ES 3042</td>
<td>Environmental Ecology Laboratory</td>
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<tr>
<td>ES 3203</td>
<td>Environmental Law</td>
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<td>B. 6 additional semester credit hours from the following courses:</td>
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<tr>
<td>ES 3123</td>
<td>Introduction to Soils</td>
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<tr>
<td>ES 3143</td>
<td>Watershed Processes</td>
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<tr>
<td>ES 4133</td>
<td>Natural Resource Policy and Administration</td>
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<td>ES 4163</td>
<td>Renewable Energy</td>
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<td>ES 4203</td>
<td>Environmental Assessment</td>
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<tr>
<td>ES 4213</td>
<td>Conservation Biology</td>
<td></td>
</tr>
<tr>
<td>ES 4233</td>
<td>Restoration Ecology</td>
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</tbody>
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Total Credit Hours

22

Biology (BIO) Courses

BIO 1033. Drugs and Society. (3-0) 3 Credit Hours. (TCCN = PHED 1346)  
An examination of licit and illicit drugs and their biosocial effects. Topics include pharmacology of alcohol, stimulants, hallucinogens, addiction, and abuse. May be applied toward the Core Curriculum requirement in Social and Behavioral Sciences. Same as NDRB 1033. Credit cannot be earned for both NDRB 1033 and BIO 1033. Generally offered: Fall, Spring. Course fees: LRC1 $12; LRS1 $46.20; DL01 $75; STSI $21.60.

BIO 1053. Introductory Microbiology. (3-0) 3 Credit Hours. (TCCN = BIOL 2320)  
Prerequisite: BIO 1203 (formerly BIO 1404) or BIO 1233. A general study of microorganisms, their characteristics, isolation, growth, and importance in nature, industry, public health, and human disease. (Formerly AHS 1053. Same as MMI 1053. Credit can only be earned for one of the following courses: BIO 1053, AHS 1053, or MMI 1053. BIO 1053 cannot substitute for BIO 3713.) Generally offered: Fall, Spring. Course Fees: LR1 $46.20; STSI $21.60.
BIO 1061. Introductory Microbiology Laboratory. (0-3-0) 1 Credit Hour. (TCCN = BIOL 2120)
Prerequisites: BIO 1233 or BIO 1203 (formerly BIO 1404), and completion of or concurrent enrollment in BIO 1053. Course provides basic microbiology lab skills and procedures, with emphasis on the growth, identification, and control of microbes of concern to health-care professionals. Immunodeficient and pregnant students must contact the Coordinator, Microbiology Teaching Labs, for additional instructions prior to the class start date. (Formerly AHS 1061 in previous catalogs and same as MMI 1061. Credit cannot be earned for more than one of BIO 1061, AHS 1061, or MMI 1061. BIO 1061 cannot substitute for BIO 3722.) Generally offered: Fall, Spring, Summer. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20; DL01 $25.

BIO 1173. Introduction to Computational Biology. (3-0) 3 Credit Hours.
Prerequisite: MAT 1193. Introduction to computation for biologists, using a modern, open-source programming language such as Python or R. Programming concepts, including data types, functions, loops, and logic are explored within a context of realistic biological problems and data sets. Basic data visualization techniques are also explored. Generally offered: Fall, Spring, Summer. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $21.60.

BIO 1201. Biosciences I Laboratory for Science Majors. (0-3-0) 1 Credit Hour. (TCCN = BIOL 1106)
Prerequisite: Completion of or concurrent enrollment in one of the following: STA 1053, MAT 1023, MAT 1073, or higher. Corequisite: BIO 1203 for biology majors. This laboratory-based course accompanies BIO 1203, Biosciences I for Science Majors. Laboratory activities will reinforce the fundamental principles of living organisms, including physical and chemical properties of life, organization, function, evolutionary adaptation, and classification. Study and examination of the concepts of cytology, reproduction, genetics, and scientific reasoning are included. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20.

BIO 1203. Biosciences I for Science Majors. (3-0) 3 Credit Hours. (TCCN = BIOL 1306)
Prerequisite: Completion of or concurrent enrollment in one of the following: STA 1053, MAT 1023, MAT 1073, or higher. Corequisite: BIO 1201 is required for biology majors. This is the first course in a two-part introduction to the science of biology for students majoring in biology or interested in pre-health professions. Topics include biochemistry, cell biology, genetics and molecular biology. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. (Formerly BIO 1053 in previous catalogs. Credit can only be earned for one of the following courses: BIO 1203, BIO 1404, or BIO 1113.) Generally offered: Fall, Spring, Summer. Course Fees: LRC1 $12; LRS1 $46.20; STSI $21.60.

BIO 1221. Biosciences II Laboratory for Science Majors. (0-3-0) 1 Credit Hour. (TCCN = BIOL 1107)
Prerequisite: BIO 1203 and BIO 1201 (or equivalent). Corequisite: BIO 1223 is required for biology majors. This laboratory-based course accompanies BIO 1223, Biosciences II for Science Majors. Laboratory activities will reinforce study of the diversity and classification of life, including animals, plants, protists, fungi, and prokaryotes. Special emphasis will be given to anatomy, physiology, ecology, and evolution of plants and animals. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20.

BIO 1223. Biosciences II for Science Majors. (3-0) 3 Credit Hours. (TCCN = BIOL 1307)
Prerequisite: BIO 1203. Concurrent enrollment in BIO 1221 is required for biology majors. This is the second course in a two-part introduction to the science of biology for students majoring in biology or interested in pre-health professions. Topics include evolutionary biology, biotic diversity, plant structure and function, and ecology. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. (Course formerly listed as BIO 1143, BIO 1413, and BIO 1414 in previous catalogs. Credit cannot be earned for more than one of the following: BIO 1143, BIO 1223, BIO 1413, BIO 1414, or ES 2013.) Generally offered: Fall, Spring, Summer. Course Fees: LRC1 $12; LRS1 $46.20; STSI $21.60.

BIO 1233. Contemporary Biology I. (3-0) 3 Credit Hours. (TCCN = BIOL 1308)
This is the first course in a two-part introduction to the science of biology for non-majors. This course focuses on the chemical basis of life, principles of inheritance, principles of evolution and biodiversity. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. May not be applied to a B.S. degree in Biology or B.S. degree in Microbiology and Immunology. Generally offered: Fall, Spring, Course Fees: LRC1 $12; LRS1 $46.20; STSI $21.60. DL01 $75.

BIO 1243. Contemporary Biology II. (3-0) 3 Credit Hours. (TCCN = BIOL 1309)
This is the second course in a two-part introduction to the science of biology for non-majors. This course focuses on evolution, animal and plant physiology, and ecology. May be applied toward the Core Curriculum requirement in Life and Physical Sciences. May not be applied to a B.S. degree in Biology or the B.S. degree in Microbiology and Immunology. Generally offered: Fall, Spring, Summer. Course Fees: DL01 $75; LRC1 $12; LRS1 $46.20; STSI $21.60.

BIO 2003. Biology of Human Reproduction. (3-0) 3 Credit Hours.
An in-depth look at human reproductive anatomy, physiology, and behavior. Topics to be considered include anatomy, sex differentiation, neuroendocrine physiology, conception and development, birth control, and sexually transmitted diseases. (Formerly BIO 1023 in previous catalogs. Credit cannot be earned for both BIO 2003 and BIO 1023.) Generally offered: Spring. Course Fees: LRS1 $46.20; STSI $21.60.

BIO 2043. Nutrition. (3-0) 3 Credit Hours. (TCCN = BIOL 1322)
Prerequisite: BIO 1233 or BIO 1203 (formerly BIO 1404). In-depth study of nutrient classes in foods: their ingestion, digestion, absorption and utilization by the human body. Clinical consequences of nutrient deficiency or excess, and Medical Nutrition Therapy to complement management of disease. (Formerly AHS 2043 in previous catalogs. Same as NDT 2043. Credit cannot be earned for more than one of the following courses: AHS 2043, BIO 2043, or NDT 2043.) Generally offered: Fall, Spring, Summer. Course Fees: LRS1 $46.20; STSI $21.60. DL01 $75.

BIO 2051. Human Anatomy and Physiology Laboratory I. (0-3-0) 1 Credit Hour. (TCCN = BIOL 2101)
Prerequisites: BIO 1203 or BIO 1233; previous or concurrent enrollment in BIO 2053 is required. This laboratory supplements the BIO 2053 lecture. Designed for pre-nursing and allied health students. Not recommended for pre-medical and pre-dental students. It is the first of a two-course laboratory sequence that uses both dissections of representative organisms and laboratory experimentation to study human anatomical systems and physiological systems. (Same as BIO 3642. Credit cannot be earned for both BIO 2051 and BIO 3642. BIO 2051 cannot substitute for BIO 3422.) Generally offered: Fall, Spring, Summer. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20; DL01 $25.
BIO 2053. Human Anatomy and Physiology I. (3-0) 3 Credit Hours. (TCCN = BIOL 2301)
Prerequisite: BIO 1203 or BIO 1233; concurrent enrollment in BIO 2051 is required. Designed for pre-nursing and allied health students. Not recommended for pre-medical and pre-dental students. This is the first of a two-course sequence that provides an integrative study of the anatomy and physiology of the human body with an emphasis on the structure/function interrelationships between organ systems. Topics covered include cell and tissue biology, the integumentary, skeletal, muscular, and nervous systems. (Same as BIO 3643. Credit cannot be earned for both BIO 2053 and BIO 3643. BIO 2053 cannot substitute for BIO 3413.) Generally offered: Fall, Spring, Summer. Course Fees: LRS1 $46.20; STSI $21.60; DL01 $75.

BIO 2061. Human Anatomy and Physiology Laboratory II. (0-3) 1 Credit Hour. (TCCN = BIOL 2102)
Prerequisites: BIO 2051; previous or concurrent enrollment in BIO 2063 is required. Designed for pre-nursing and allied health students. Not recommended for pre-medical and pre-dental students. This laboratory supplements the BIO 2063 lecture. It is the second of a two-course laboratory sequence that uses both dissections of representative organisms and laboratory experimentation to study human anatomical systems and physiological processes. (Same as BIO 3652. Credit cannot be earned for both BIO 2061 and BIO 3652. BIO 2061 cannot substitute for BIO 3422.) Generally offered: Fall, Spring, Summer. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20; DL01 $25.

BIO 2063. Human Anatomy and Physiology II. (3-0) 3 Credit Hours. (TCCN = BIOL 2302)
Prerequisite: BIO 2053; concurrent enrollment in BIO 2061 is required. Designed for pre-nursing and allied health students. Not recommended for pre-medical and pre-dental students. This is the second of a two-course sequence that provides an integrative study of the anatomy and physiology of the human body with an emphasis on the structure/function interrelationships between organ systems. Topics covered include the endocrine, digestive, respiratory, cardiovascular, lymphatic/immune, renal and reproductive systems. Human growth and development will also be covered. (Same as BIO 3653. Credit cannot be earned for both BIO 2063 and BIO 3653. BIO 2063 cannot substitute for BIO 3413.) Generally offered: Fall, Spring, Summer. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20; DL01 $25.

BIO 2073. Sophomore Research Experience. (1-4) 3 Credit Hours.
Prerequisite: BIO 1203, BIO 1201, BIO 1223, and BIO 1221 with a grade of at least a 'C'. Restricted to students who have completed 30 or more hours. The organizing principles of biology (such as molecular and cellular functions, reproduction, development, homeostatic mechanisms, and organismal physiology and behavior) are used within a comparative and evolutionary framework to train students in modern laboratory techniques, bioinformatics, experimental design, and interpretation of results. Generally offered: Fall and Spring.

BIO 2313. Genetics. (3-0) 3 Credit Hours. (TCCN = BIOL 2316)
Prerequisites: BIO 1223 and completion or concurrent enrollment in one of the following: MAT 1093 (or higher) or STA 1053. Principles governing transmission of hereditary factors in plants and animals, with emphasis on molecular, biochemical, and population genetics. Generally offered: Fall, Spring, Summer. Course Fees: LRS1 $46.20; STSI $21.60; DL01 $75.

BIO 2362. Molecular Genetics Laboratory. (1-4) 2 Credit Hours.
Prerequisites: BIO 1223, CHE 1103, and completion or concurrent enrollment in MAT 1093 or higher. A study of techniques used to investigate the inheritance of genetic information at the molecular level. Students will gain an understanding of the structure, function and regulation of genes. Techniques will include; nucleic acid biochemistry, molecular cloning mutagenesis and bioinformatics. (Formerly BIO 2322. Credit cannot be earned for both BIO 2362 and BIO 2322.) Generally offered: Fall, Spring, Summer. Course Fees: L001 $30; LRS1 $30.80; STSI $14.40; DL01 $50.

BIO 2953. Special Topics in Biology. (3-0) 3 Credit Hours.
An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Topics may be repeated for credit when the topics vary, but not more than 6 semester credit hours will apply to a bachelor’s degree, regardless of discipline. No more than 6 semester credit hours of BIO 2953, BIO 4951, or BIO 4953 can be applied to a Bachelor of Science degree in Biology or Microbiology and Immunology. Course Fees: IUS1 $46.20; STSI $21.60.

BIO 2992. Medical Terminology. (2-0) 2 Credit Hours.
Prerequisite: BIO 1203 and BIO 1223 with a grade of at least a 'C'. This course covers the language of medicine that will be used as a foundation for understanding upper-division undergraduate and graduate-level courses to follow. It will include pronunciation, definition, usage, and origins of medical terms. Medical terms presented will be used to identify signs, symptoms, diagnoses, and treatment options for selected pathologies. With these skills the student will be able to effectively interpret and communicate in a healthcare setting. Generally offered: Fall. Course Fees: LRS1 $30.80; STSI $14.40.

BIO 3013. Introduction to Clinical Medicine and Pathology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203, BIO 1223, BIO 2313, and BIO 2992. Introduction to concepts of human disease, diagnosis, and underlying pathology. Same as MMI 3013. Credit cannot be earned for both BIO 3013 and MMI 3013. Generally offered: Fall. Differential Tuition: $150.

BIO 3043. UTeachSA Research Methods. (3-0) 3 Credit Hours.
Prerequisite: This course is only open to students who are participating in the UTeachSA teacher preparation program. Students design and carry out independent inquiries, which they write up and present in the manner that is common in the scientific community. Inquiries incorporate mathematics and the various science disciplines to solve research problems. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. (Same as UTE 3043. Credit cannot be earned for both BIO 3043 and UTE 3043.) Generally offered: Fall. Spring. Differential Tuition: $150.

BIO 3053. Sophomore Research Experience. (1-4) 3 Credit Hours.
Prerequisite: BIO 1203, BIO 1201, BIO 1223, and BIO 1221 with a grade of at least a 'C'. Restricted to students who have completed 30 or more hours. The organizing principles of biology (such as molecular and cellular functions, reproduction, development, homeostatic mechanisms, and organismal physiology and behavior) are used within a comparative and evolutionary framework to train students in modern laboratory techniques, bioinformatics, experimental design, and interpretation of results. Generally offered: Spring. Differential Tuition: $150.
BIO 3073. Environmental Rhetoric and Technical Communication. (3-0) 3 Credit Hours.
Prerequisite: ENG 2413. Restricted to students who have completed 60 or more hours. This course focuses on rhetoric, ecology, and technical/scientific communication in order to develop interdisciplinary, team-based, and applied research projects. This advanced professional writing and rhetoric course will examine ecological communications as an archetypal example of specialized technical communication. (Same as ES 3073. Credit cannot be earned for both BIO 3073 and ES 3073.) Generally offered: Fall, Spring. Differential Tuition: $150.

BIO 3113. Ichthyology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1203 and BIO 1223 with a grade of at least a 'C'.
Restricted to students who have completed 60 or more hours. This course will focus on form and function, behavior, life history, ecology, and key taxonomic characteristics of most of the orders of fishes. Field trips may be required. (Same as ES 3113. Credit cannot be earned for both BIO 3113 and ES 3113.) Generally offered: Spring. Differential Tuition: $150. Course Fees: IUS1 $15; STFB $40.

BIO 3123. Comparative Vertebrate Anatomy. (3-0) 3 Credit Hours.
Prerequisite: BIO 1203 and BIO 1223 with a grade of at least a 'C'.
Restricted to students who have completed 60 or more hours. Not recommended for pre-medical and pre-dental students. A comparative analysis of developmental and adult anatomy of vertebrates (including humans). Emphasis is placed on phylogenetic relationships between form, function, and evolution. Generally offered: Spring. Differential Tuition: $150. Course fee: DL01 $75.

BIO 3213. Animal Behavior. (3-0) 3 Credit Hours.
Prerequisite: BIO 1203 and BIO 1223 with a grade of at least a 'C'.
Restricted to students who have completed 60 or more hours. This course will introduce various approaches to the study of animals and their behavior in natural habitats. The course will examine basic principles derived from studying the evolution, ecology, and development of animals, and use these principles to explain how and why animals behave as they do in particular situations. (Same as NDRB 3213. Credit cannot be earned for both NDRB 3213 and BIO 3213.) Generally offered: Fall, Summer. Spring. Differential Tuition $150. Course fee: DL01 $75.

BIO 3233. Survey of Insects. (3-0) 3 Credit Hours.
Prerequisite: BIO 1203 and BIO 1223 with a grade of at least a 'C'.
Restricted to students who have completed 60 or more hours. Includes an introduction to basic insect biology, as well as in-depth coverage of insect systematics, including major orders and families. (Same as ES 3233. Credit cannot be earned for both BIO 3233 and ES 3233.) Generally offered: Spring even years. Differential Tuition: $150.

BIO 3253. R Coding in Environmental Science and Ecology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1173 or CS 1173 with a grade of at least a 'C'. This course will teach the management of environmental and ecological data using Program R. The focus will be on the structure and linguistics of data in R and how to integrate R into a data science workflow. (Same as ES 3253. Credit cannot be earned for both BIO 3253 and ES 3253.)

BIO 3263. The Woody Plants. (2-3) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a 'C'.
Restricted to students who have completed 60 or more hours. A study of the woody plants, emphasizing the characteristics of family, genus, and species. Includes identification of the common woody plants. Leaf, stem, and flower morphology, anatomy, and collecting techniques. Lecture, laboratory, and fieldwork will be included as part of the course. (Same as ES 3263. Credit cannot be earned for both BIO 3263 and ES 3263.)

BIO 3273. Biology of Flowering Plants. (2-3) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a 'C'.
Restricted to students who have completed 60 or more hours. A study of the wildflowers of Texas emphasizing identification of the more common wildflowers, as well as family characteristics. Flower anatomy, plant morphology, and plant-collecting techniques will be included. Lecture, laboratory, and fieldwork will be included as part of the course. (Same as ES 3273. Credit cannot be earned for both BIO 3273 and ES 3273.)
Generally offered: Spring. Differential Tuition $150.

BIO 3283. Principles of Ecology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1223. A study of the interaction of organisms with their environment, with focus on ecological principles, adaptations of organisms, environmental pollution, and principles of conservation. (Same as ES 3033. Credit cannot be earned for both BIO 3283 and ES 3033.)
Generally offered: Fall, Spring, Summer. Differential Tuition: $150.

BIO 3292. Principles of Ecology Laboratory. (0-6) 2 Credit Hours.
Prerequisites: BIO 1223 and completion of or concurrent enrollment in BIO 3283. A field-oriented course emphasizing modern ecological techniques, including examinations of plant and animal populations and measurement of selected chemical and physical parameters. (Same as ES 3042. Credit cannot be earned for both BIO 3292 and ES 3042.)
Generally offered: Fall, Spring, Summer. Differential Tuition: $100. Course Fees: IUS1 $15; L001 $30; STFB $40.

BIO 3293. Mammalogy. (3-0) 3 Credit Hours.
Prerequisite: BIO 1203 and BIO 1223 with a grade of at least a 'C'.
Restricted to students who have completed 60 or more hours. A course covering various aspects of the biology of mammals, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as ES 3173. Credit cannot be earned for both BIO 3293 and ES 3173.)
Generally offered in Fall of odd years. Differential Tuition: $150. Course Fee: IUS1 $15.

BIO 3303. Entomology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1203 and BIO 1223 with a grade of at least a 'C'.
Restricted to students who have completed 60 or more hours. A course covering various aspects of the biology of insects, including anatomy, physiology, evolution, behavior, ecology, and biogeography. (Same as ES 3183. Credit cannot be earned for both BIO 3303 and ES 3183.)
Generally offered: Spring odd years. Field trips may be required. Differential Tuition: $150.

BIO 3323. Evolution. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203, BIO 1223, and BIO 2313 with a grade of at least a 'C'.
Restricted to students who have completed 60 or more hours. A discussion of theories and possible mechanisms for evolutionary changes at various levels of organization. (Same as MMI 3323. Credit cannot be earned for both BIO 3323 and MMI 3323.)
BIO 3333. Plants and Society. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a 'C-'.
Restricted to students who have completed 60 or more hours. The importance of plants and plant-derived products to human health and wellbeing through the provision of food, pharmaceuticals, and other important natural products. (Formerly listed as BIO 2343 in previous catalogs. Credit cannot be earned for both BIO 3333 and BIO 2343.) Generally offered: Spring. Differential Tuition $150.

BIO 3343. Plant Cell Biology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a 'C-'.
Restricted to students who have completed 60 or more hours. A comprehensive study of the molecular structures and functions of plant cells and their integration into the whole plant system. (Formerly titled "Plant Sciences.") Generally offered: Spring. Differential Tuition $150.

BIO 3353. Herpetology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1203 and BIO 1223 with a grade of at least a 'C-'.
Restricted to students who have completed 60 or more hours. A course covering various aspects of the biology of amphibians and reptiles, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. (Same as ES 3193. Credit cannot be earned for both BIO 3353 and ES 3193.) Field trips may be required. Differential Tuition: $150. Course Fee: IUS1 $15.

BIO 3362. Molecular Biochemistry Laboratory. (1-4) 2 Credit Hours.
Prerequisites: BIO 2362, CHE 1103, and completion or concurrent enrollment in MAT 1093 or higher. A study of the microscopic, biochemical and molecular techniques used to investigate biochemical reactions and the structure and function of proteins in cells and tissues. Techniques will include; protein extraction, protein characterization, enzyme kinetics, chromatography, western blotting, Immunofluorescence and bioinformatics. (Same as BIO 3522, BIO 3822, NDRB 3362, and BME 3114. Credit cannot be earned for both BIO 3362 and any of the following: BIO 3522, BIO 3822, NDRB 3362, or BME 3114.) Generally offered: Fall, Spring, Summer. Differential Tuition: $100. Course Fees: IUS1 $15; L001 $30; DL01 $50.

BIO 3382. Sophomore Research Initiative Peer Mentor. (0-0) 2 Credit Hours.
Prerequisites: BIO 3362, completion of the Sophomore Research Initiative, and instructor consent. Student will be a peer mentor for students in the Sophomore Research Initiative (SRI) in a laboratory in which they were previously enrolled, and which they completed with a grade of "A" or "B". Students will work under the guidance of a graduate teaching assistant or laboratory coordinator. Besides assisting in the laboratory, students will be expected to attend group meetings associated with the laboratory, help with setup of the laboratories and complete a written assignment at the end of the semester. Students will not have any student grading responsibility. Cannot be repeated for credit. Differential Tuition: $100. Course Fees: IUS1 $15; L001 $30.

BIO 3413. Physiology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a 'C-'. Physiology of systems of higher animals and plants, including circulation, regulation of body fluids, nervous system, muscle, sensory systems, and photosynthesis. Generally offered: Fall, Spring, Summer. Differential Tuition: $150. Course fee: DL01 $75.

BIO 3422. Physiology Laboratory. (1-5) 2 Credit Hours.
Prerequisite: Completion or concurrent enrollment in BIO 3413. Basic understanding of the physiological processes in living systems employing methods and instruments of biological research. Generally offered: Fall, Spring, Summer. Differential Tuition: $100. Course Fees: DL01 $50; IUS1 $15; L001 $30.

BIO 3433. Neurobiology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1203 with a grade of at least a 'C-'. Restricted to students who have completed 60 or more hours. Anatomy and physiology of nervous systems; the mechanisms of neuronal functions. Same as NDRB 3433. Credit cannot be earned for both BIO 3433 and NDRB 3433. Generally offered: Fall, Spring. Differential Tuition: $150. Course fee: DL01 $75.

BIO 3442. Neurobiology Laboratory. (0-4) 2 Credit Hours.
Prerequisites: BIO 1203 with a grade of at least a C, and completion of or concurrent enrollment in BIO 3433. Restricted to students who have completed 60 or more hours. A laboratory course emphasizing principles presented in BIO 3433. Same as NDRB 3442. Credit cannot be earned for both BIO 3442 and NDRB 3442. Generally offered: Fall, Spring. Differential Tuition: $100. Course Fees: IUS1 $15; L001 $30; DL01 $50.

BIO 3513. Biochemistry. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203, BIO 1223, and CHE 3643 with a grade of at least a 'C-'. Restricted to students who have completed 60 or more hours. Introduction to biochemistry: amino acids, protein structure, enzymes, lipids, metabolism, nucleic acid structure, bioenergetics, and carbohydrates. (Same as CHE 4303. Credit cannot be earned for both BIO 3513 and CHE 4303.) Generally offered: Fall, Spring, Summer. Differential Tuition: $150. Course fee: DL01 $75.

BIO 3523. Advanced Computational Biology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1173 or CS 1173 with a grade of at least a 'C-'. Development and application of computational approaches to biological questions, with focus on formulating interdisciplinary problems as computational problems and then solving these problems using algorithmic techniques. Generally offered: Spring. Differential tuition: $150. Course fee: IUS1 $15.

BIO 3623. Neuropsychopharmacology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a 'C-'. Restricted to students who have completed 60 or more hours. BIO 3433 is recommended. A study of the pharmacology of drugs that affect the function of the central nervous system. Topics include drug-receptor interactions, drugs of abuse, and drugs used to treat mental illness. (Same as NDRB 3623. Credit cannot be earned for both BIO 3623 and NDRB 3623.) Generally offered: Fall. Differential Tuition: $150. Course fee: DL01 $75.

BIO 3642. Clinical Anatomy Laboratory I. (0-6) 2 Credit Hours.
Prerequisite: BIO 2992 and BIO 3413 with a grade of at least a 'C-'. Concurrent enrollment in 3643 required. Designed for pre-medical and pre-dental students. Not recommended for pre-nursing and allied health students. This is the first laboratory course in a two part series that teaches the structure of the human body at a level required for clinical medicine. Same as BIO 2051. Credit cannot be earned for both BIO 2051 and BIO 3642. Generally offered: Fall. Differential Tuition: $100. Course Fees: IUS1 $15; L001 $30.

BIO 3643. Advanced Physiology I. (3-0) 3 Credit Hours.
Prerequisite: BIO 2992 and BIO 3413 with a grade of at least a 'C-'. Concurrent enrollment in 3642. This is the first lecture course in a two part series that teaches the structure and functions of the human body at a level required for clinical medicine. The course covers normal physiology, as well as selected diseases. This course will cover foundational basics on the cell, body fluids, the autonomic nervous system, and endocrine system. The ultimate goal is for students to develop an understanding of the integrated functions of the normal body and “problem solving” and “critical thinking” skills in evaluating clinical situations. Same as BIO 2053. Credit cannot be earned for BIO 2053 and BIO 3643. Generally offered: Fall. Differential Tuition: $150.
BIO 3652. Clinical Anatomy Laboratory II. (0-6) 2 Credit Hours.
Prerequisite: BIO 3643 and BIO 3642 with a grade of at least a 'C-'.
Concurrent enrollment in BIO 3653 required. Designed for pre-medical and
pre-dental students. Not recommended for pre-nursing and allied health
students. This is the second laboratory course in a two part series that
teaches the structure and functions of the human body at a level required for clinical
medicine. Same as BIO 2061. Credit cannot be earned for both BIO 2061
and BIO 3652. Generally offered: Spring. Differential Tuition: $100. Course Fees:
IUS1 $15; L001 $30.

BIO 3653. Advanced Physiology II. (3-0) 3 Credit Hours.
Prerequisite: BIO 3643 and BIO 3642 with a grade of at least a 'C-'.
Designed for pre-medical and pre-dental students. Not recommended for pre-nursing and allied health students. This is the second lecture course in a two part series that teaches the structure and functions of the human body at a level required for clinical medicine. The course covers cardiovascular, respiratory, renal, and gastrointestinal; with a final integration section which applies the physiological principles learned to special situations. The ultimate goal is for students to develop an understanding of the integrated functions of the normal body and "problem solving" and "critical thinking" skills in evaluating clinical situations. Same as BIO 2063. Credit cannot be earned for BIO 2063 and BIO 3653. Generally offered: Spring. Differential Tuition: $150.

BIO 3663. Human Embryology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203, BIO 1223, and BIO 2313 with a grade of at least a 'C-'.
Restricted to students who have completed 60 or more hours.
Development of the human embryo from fertilization to the birth of the
fetus. The origin of various tissues and organs will be followed
during development. Environmental and genetic factors that can alter
development will be discussed. Same as NDRB 3663. Credit cannot be earned for both BIO 3663 and NDRB 3663. Generally offered: Fall.
Differential Tuition: $150.

BIO 3713. Microbiology. (3-0) 3 Credit Hours.
Prerequisite: BIO 1203 and BIO 1223; restricted to students who have
completed 60 or more hours; concurrent enrollment in MMI 3722 is
recommended for students intending to complete both courses. A
comprehensive study of microorganisms, including their composition,
morphology, growth, metabolism, classification, ecology, and significance in disease. BIO 1053 cannot substitute for BIO 3713. (Same as MMI 3713.
Credit cannot be earned for MMI 3713, BIO 3713, and ES 3103.) Generally offered: Fall, Spring, Summer. Differential Tuition: $150. Course fee: DL01 $75.

BIO 3722. Microbiology Laboratory. (0-6) 2 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with at least a C.; and completion
of or concurrent enrollment in BIO 3713. Restricted to students with
60 or more hours. Basic microbiology techniques with emphasis on
microscopy; cell staining and characterization; species isolation
techniques; bacterial cultivation, nutrition, and physical requirements;
and the physical and chemical control of microbes. Immunodeficient and pregant students must contact the Coordinator, Microbiology Teaching Labs, for additional instructions prior to the class start date. BIO 1061 cannot substitute for BIO 3722. Same as MMI 3722. Credit cannot be earned for both BIO 3722 and MMI 3722. Generally offered: Fall, Spring, Summer. Differential Tuition: $100. Course Fees: IUS1 $15; L001 $30; DL01 $50.

BIO 3743. Bacteriology. (3-0) 3 Credit Hours.
Prerequisite: BIO 2313 and BIO 3713 with a grade of at least a 'C-'.
Restricted to students with at least 60 hours. A study of the phylogeny of
prokaryotes; structure and function of prokaryotic cells; ecology
and physiological diversity of prokaryotes; growth and control of
microorganisms; genetics of bacteria and bacteriophages; bacteria as
agents of disease; antibacterials and other chemotherapeutics; human
applications of microbiology, microbial genomics, and principles of
microbial biotechnology. Same as MMI 3743. Credit cannot be earned for
both BIO 3743 and MMI 3743. Generally offered: Fall. Differential Tuition:
$150. Course fee: DL01 $75.

BIO 3813. Cell Biology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203, BIO 1223, and BIO 2313 with a grade of at least
a 'C-'. Restricted to students who have completed 60 or more hours.
BIO 3813 is recommended. A study of cellular molecules and metabolic
processes; synthesis and regulation of macromolecules; differential
gene expression; membranes and organelles; cytoskeleton; cell cycle
and growth of normal and neoplastic cells. (Same as BME 3114 and
NDRB 3813. Credit cannot be earned for both BIO 3813 and BME 3114
or BIO 3813 and NDRB 3813.) Generally offered: Fall, Spring, Summer.
Differential Tuition: $150. Course fee: DL01 $75.

BIO 3913. Molecular Biology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203, BIO 1223, and BIO 2313 with a grade of at least
a 'C-'. Restricted to students who have completed 60 or more hours.
BIO 3913 is recommended. A study of nucleotides, DNA, replication,
recombination, RNA, transcription, genetic code, translation, genomes,
and chromosomes. Same as NDRB 3913. Credit cannot be earned for

BIO 3933. Principles of Cancer Biology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a 'C-'.
Restricted to students who have completed 60 or more hours. BIO
3813 is recommended. A study of the underlying molecular and cellular
biology involved in carcinogenesis, the roles of oncogenes and tumor
suppressor genes in cancer development and progression, and modern
technologies in cancer screening, diagnosis, treatments, and prevention.
Upon completion of the class, students should have gained a basic
understanding of the mechanisms by which tumors arise and progress
to cancer, potential therapeutic targets in cancer treatments, and an
individual's actions that are expected to decrease the chances of cancer
development. Same as NDRB 3993. Credit cannot be earned for both BIO
3933 and NDRB 3993. Generally offered: Fall, Spring. Differential Tuition
$150.

BIO 4033. Conservation Biology. (3-0) 3 Credit Hours.
Prerequisite: BIO 3283 with a grade of at least a 'C-'. The class topics
will include studying the nature of the biosphere, threats to its integrity,
and ecologically sound responses to these threats. Also included will be
the origin and preservation of biotic diversity, how the rich variety of
plant and animal life around us arose, how it has been maintained by
natural processes, and how we can prevent its destruction. (Same as ES
4213. Credit cannot be earned for both BIO 4033 and ES 4213.) Generally offered: Fall. Differential Tuition: $150. Course fee: DL01 $75.
BIO 4043. Desert Biology. (2-3) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a ‘C’.
Restricted to students who have completed 60 or more hours, or consent of instructor. Concurrent enrollment in BIO 4233 and BIO 4241 required. A study of the deserts of the world with an emphasis on U.S. deserts. Adaptations of plants and animals and their responses to desert conditions, as well as examinations of desert climatic patterns, geology, and natural history. Lecture, laboratory, and fieldwork will be included. (Same as ES 4123. Credit cannot be earned for both BIO 4043 and ES 4123.) Generally offered: Summer. Differential Tuition $150.

BIO 4053. Wildlife Ecology. (3-0) 3 Credit Hours.
Prerequisites: BIO 3283 with a grade of at least a ‘C’. Major environmental factors affecting wildlife; structure and behavior of wildlife populations; regional wildlife communities and their conservation. Field studies will allow students to observe and apply classroom topics. (Same as ES 4243. Credit cannot be earned for both BIO 4053 and ES 4243.) Generally offered: Fall. Differential Tuition: $150.

BIO 4063. Ornithology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a ‘C’. Restricted to students who have completed 60 or more hours. A course covering various aspects of the biology of birds, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips will be included. (Same as ES 3163. Credit cannot be earned for both BIO 4063 and ES 3163.) Generally offered: Spring. Differential Tuition $150.

BIO 4143. Developmental Biology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203, BIO 1223, and BIO 2313 with a grade of at least a ‘C’. This course focuses on the origins of classical concepts as well as modern molecular approaches. Emphasis will be placed on the mechanisms underlying developmental processes using both invertebrate and vertebrate examples. Subjects include axis formation, induction, morphogenesis, embryonic pattern formation, cell differentiation, and organogenesis. (Formerly listed as BIO 3143 in previous catalogs. Same as NDRB 4143. Credit cannot be earned for both BIO 4143 and BIO 3143 or BIO 4143 and NDRB 4143.) Generally offered: Fall. Differential Tuition: $150.

BIO 4223. Field Biology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a ‘C’. Restricted to students who have completed 60 or more hours, or consent of instructor. Corequisites: BIO 4241 and BIO 4033. A field-oriented course offering the opportunity for practical experience observing, collecting, and identifying Texas plants and animals. (Same as ES 4133. Credit cannot be earned for both BIO 4223 and ES 4133.) Generally offered: Summer. Differential Tuition $150. Course Fees: IUS1 $15; L001 $30.

BIO 4241. Field Biology Laboratory. (0-3) 1 Credit Hour.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a ‘C’. Restricted to students who have completed 60 or more hours, or consent of instructor. Concurrent enrollment in BIO 4233 and BIO 4043 required. A field-oriented course offering the opportunity for practical experience observing, collecting, and identifying Texas plants and animals. (Same as ES 4111. Credit cannot be earned for both BIO 4241 and ES 4111.) Generally offered: Summer. Differential Tuition $50. Course Fees: IUS1 $15; L001 $30.

BIO 4263. River Ecosystems. (3-0) 3 Credit Hours.
Prerequisite: BIO 3283 with a grade of at least a ‘C’. This course examines the physical, chemical, and biological factors that determine biodiversity and the structure and function of aquatic and riparian ecosystems. Key ecological and hydrogeomorphology concepts and their application to environmental concerns are covered. Same as ES 4263. Credit cannot be earned for both BIO 4263 and ES 4263. Generally offered: Spring of even years. Differential Tuition: $150.

BIO 4273. Fish Ecology. (3-0) 3 Credit Hours.
Prerequisite: BIO 3283 with a grade of at least a ‘C’. A study of the biotic and abiotic factors affecting the diversity and distribution of fishes, with a focus on North American freshwater fishes. This course will include (1) lectures and discussions covering patterns and processes in fish ecology; and (2) a collaborative research project covering computational techniques used in fish ecology. Same as ES 4273. Credit cannot be earned for both BIO 4273 and ES 4273. Generally offered: Fall of even years. Differential Tuition: $150.

BIO 4283. Plant-Soil-Microbe Interactions. (3-0) 3 Credit Hours.
Prerequisite: BIO 3283 with a grade of at least a ‘C’. This course focuses on the microbial groups which live in soils and among plant species and methodologies used to understand their interaction. Same as ES 4283. Credit cannot be earned for both BIO 4283 and ES 4283. Generally offered: Fall of even years. Differential Tuition: $150.

BIO 4303. Aquatic Ecology. (3-0) 3 Credit Hours.
Prerequisite: BIO 3283 with a grade of at least a ‘C’. Restricted to students who have completed 60 or more hours. Study of aquatic ecosystems including streams, wetlands, and lakes. Topics include watershed processes, biological communities, physical habitats, nutrient cycling, energy flow, and management issues. The course culminates with individual research projects focused on local watersheds. Field trips may be required. Same as ES 4023. Credit cannot be earned for both BIO 4303 and ES 4023. Generally offered: Spring. Differential Tuition: $150. Course Fee: STFB $40.

BIO 4313. Plant Physiological Ecology. (3-0) 3 Credit Hours.
Prerequisite: BIO 3283 with a grade of ‘C’ or better. Survey of physiological approaches to understanding plant-environment interactions from the functional perspective. Same as ES 4033. Credit cannot be earned for both BIO 4313 and ES 4033. Generally offered: Fall of odd years. Differential Tuition: $150.

BIO 4323. Restoration Ecology. (3-0) 3 Credit Hours.
Prerequisite: ES 3033 or BIO 3283, or equivalents. Applies ecological principles to the restoration of disturbed terrestrial, wetland, and aquatic ecosystems. Includes the restoration of soils and waterways, of flora and fauna, and of natural ecological processes such as plant succession and nutrient cycling. Same as ES 4233. Credit cannot be earned for both BIO 4323 and ES 4233. Generally offered: Spring. Differential Tuition: $150.

BIO 4453. Endocrinology. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203, BIO 1223, and BIO 2313 with a grade of at least a ‘C’. Restricted to students who have completed 60 or more hours. Molecular, cellular, and physiological effects of hormones in health and disease. Topics include molecular mechanisms of hormone action in reproductive physiology, growth, and development, as well as defects in hormonal regulation underlying clinically important syndromes (e.g., diabetes, hypertension, osteoporosis, and cancer). Same as NDRB 4453. Credit cannot be earned for BIO 4453 and NDRB 4453. Generally offered: Fall. Differential Tuition: $150. Course fee: DL01 $75.
BIO 4473. Advanced Clinical Medicine and Pathology. (3-0) 3 Credit Hours.
Prerequisite: BIO 3013 with a grade of at least a 'C-'. Advanced concepts of human disease, diagnosis, and underlying pathology. Same as MMI 4473. Credit cannot be earned for both BIO 4473 and MMI 4473. Generally offered: Spring. Differential Tuition $150.

BIO 4483. Medical Mycology. (3-0) 3 Credit Hours.
Prerequisites: BIO 3713 and BIO 3722 with a grade of at least a 'C'. Comprehensive study of causative agents, pathogenesis, and treatment of human fungal diseases. Same as MMI 4483. Credit cannot be earned for both BIO 4483 and MMI 4483. Generally offered: Spring. Differential Tuition $150. Course fee: DL01 $75.

BIO 4753. Microbial Genomes and Virulence. (3-0) 3 Credit Hours.
Prerequisite: BIO 3013 and BIO 3713 with a grade of at least a 'C'. Credit cannot be earned for both BIO 4753 and MMI 4753. Generally offered: Fall. Differential Tuition $150.

BIO 4773. Microbial Ecology and Metagenomics. (3-0) 3 Credit Hours.
Prerequisites: BIO 1053 and BIO 2313. This course will provide an overview of microbial ecology principles and application of microbial ecological approaches to understand microbial structure and function across environments, including the soil, freshwater and marine environments. The course will focus its content on prokaryotes and fungi. An emphasis in this course will be on learning foundational concepts in microbiome science and applying concepts to laboratory and computational techniques through hands-on experiments. Same as MMI 4773. Credit cannot be earned for both BIO 4773 and MMI 4773. Generally offered: Fall, Spring. Differential Tuition: $150.

BIO 4783. Medical Mycology. (3-0) 3 Credit Hours.
Prerequisites: BIO 3713 and BIO 3722 with a grade of at least a 'C'. Comprehensive study of causative agents, pathogenesis, and treatment of human fungal diseases. Same as MMI 4483. Credit cannot be earned for both BIO 4483 and MMI 4483. Generally offered: Spring. Differential Tuition: $150.

BIO 4813. Brain and Behavior. (3-0) 3 Credit Hours.
Prerequisites: BIO 1203 and BIO 1223 with a grade of at least a 'C'. Restricted to students who have completed 60 or more hours. This course explores the brain basis of behavior, with a focus on understanding the neurophysiological, neurochemical, and neuroanatomical underpinnings for a variety of simple and complex behaviors. Students will explore topics such as sensation and perception, pain, movement, sleep, biological rhythms, emotions, addiction, learning and memory, and neurodevelopment. The topics are grounded with examples of typical human behavior and disorders, such as Parkinson's disease, autism, schizophrenia, and psychopathology. Same as NDRB 4813. Credit cannot be earned for more than one of BIO 4813, PSY 4183, or NDRB 4813. Generally offered: Fall. Differential Tuition: $150. Course fee: DL01 $75.

BIO 4823. Cognitive Neuroscience. (3-0) 3 Credit Hours.
Prerequisite: BIO 3433 or BIO 4813 or PSY 4183, with a grade of at least a C, or consent of instructor. The biological basis of cognition, including perception, attention, learning, memory, emotion, language, and executive function. The course introduces students to the use of human neuroimaging experiments and clinical population, as well as research with other species, to study the brain basis of complex behavior and cognitive disorders, such as memory loss, language impairment, and developmental disorders. Same as NDRB 4823. Credit cannot be earned for both BIO 4823 and NDRB 4823. Generally offered: Spring. Differential Tuition $150.

BIO 4911. Independent Study. (0-0) 1 Credit Hour.
Prerequisite: Permission in writing (form available) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Only 6 semester credit hours of BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: $50.
BIO 4912. Independent Study. (0-0) 2 Credit Hours.
Prerequisite: Permission in writing (form available) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor’s degree. Generally offered: Fall, Spring, Summer. Differential Tuition: $100.

BIO 4913. Independent Study. (0-0) 3 Credit Hours.
Prerequisite: Permission in writing (form available) from the instructor, an undergraduate academic advisor, the Department Chair, and the Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor’s degree. Generally offered: Fall, Spring, Summer. Differential Tuition: $150.

BIO 4923. Laboratory Research: Biology Concentrations. (0-0) 3 Credit Hours.
Prerequisite: Permission in writing (form available in the Biology Department Office) from the faculty mentor, the student’s advisor, the Department Chair, and the Dean of the College. Supervised laboratory research mentored by a faculty member engaged in active research within the student’s designated area of concentration. May be repeated for credit, but no more than 6 semester credit hours will apply to a bachelor’s degree. Only 6 semester credit hours of BIO 3043, BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor’s degree. Generally offered: Fall, Spring, Summer. Differential Tuition: $150.

BIO 4951. Special Studies in Biology. (1-0) 1 Credit Hour.
An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree. No more than 6 semester credit hours of BIO 2953, BIO 4951, or BIO 4953 can be applied to a B.S. degree in Biology or Microbiology and Immunology. Differential Tuition: $50.

BIO 4953. Special Studies in Biology. (3-0) 3 Credit Hours.
An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree. No more than 6 semester credit hours of BIO 2953, BIO 4951, or BIO 4953 can be applied to a B.S. degree in Biology or Microbiology and Immunology. Generally offered: Fall, Spring, Summer. Differential Tuition: $150. Course fee: DL01 $75.

BIO 4981. Senior Seminar in Microbiology and Immunology. (1-0) 1 Credit Hour.
Prerequisite: Senior status, a minimum of 90 semester credit hours. This course is only open to seniors in the Microbiology and Immunology degree program. Students will learn how to interpret the scientific literature and to organize and present scientific research findings as reported in the current literature. May be repeated for credit. The grade report for the course is either "CR" (satisfactory performance) or "NC" (unsatisfactory performance). Generally offered: Fall, Spring. Differential Tuition: $50. Course fee: DL01 $25.

BIO 4993. Honors Research. (0-0) 3 Credit Hours.
Prerequisite: Students taking this course must have approval by the Honors College or College Honors Committee, must be a Biology major, must be either a member of the Honors College or pursuing College of Sciences Honors, and must be in the last two semesters of study. Supervised research and preparation of an Honors Thesis. May be repeated for credit with approval, but no more than 6 semester credit hours, regardless of discipline, will apply to a bachelor’s degree. Only 6 semester credit hours of BIO 4911-3, BIO 4923 and BIO 4993, in any combination, can be taken as BIO electives. Additional research hours of these courses (excluding Independent Study) may be taken as free electives, for a maximum of 12 research hours being applied to the bachelor’s degree. Generally offered: Fall, Spring. Differential Tuition: $150.

Environmental Sciences (ES) Courses

ES 1003. Survey Topics in Environmental Studies. (3-0) 3 Credit Hours.
A broad based survey course intended to provide a comprehensive introduction to the multidisciplinary field of environmental studies. This course examines the ecological, social, and political-economic aspects of contemporary environmental issues from an interdisciplinary perspective. May be applied toward the Core Curriculum requirement in Social and Behavioral Sciences. Generally offered: Fall and Spring. Course Fees: LRS1 $46.20; STSI $21.60.

ES 1111. Environmental Botany Laboratory. (0-3) 1 Credit Hour. (TCCN = BIOL 1111)
Laboratory studies to accompany Environmental Botany Lecture. Selected laboratories pertaining to the structure and function of plants. Generally offered: Fall and Spring. Course Fees: IUS1 $15; L001 $20; LRS1 $15.40; STSI $7.20.

ES 1113. Environmental Botany. (3-0) 3 Credit Hours. (TCCN = BIOL 1113)
Study of structure and function of plant cells, tissues, and organs. Includes an evolutionary survey and life histories of the following representative groups: algae, fungi, mosses, liverworts, ferns, and seed producing organisms. Plant reproductive and functional interactions with their environment and with humans. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall and Spring. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20.

ES 1121. Environmental Zoology Laboratory. (0-3) 1 Credit Hour. (TCCN = BIOL 1113)
Laboratory studies to accompany Environmental Zoology Lecture. Selected laboratories pertaining to the taxonomy, molecular biology, and ecology of animals. Generally offered: Fall and Spring. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20.
ES 1123. Environmental Zoology. (3-0) 3 Credit Hours. (TCCN = BIOL 1313)
Study of the principles of taxonomy, molecular biology, and ecology as they relate to animal form and function, diversity, behavior, and evolution. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall and Spring. Course Fees: LRC1 $12; LRS1 $46.20; STSI $21.60; DL01 $75.

ES 1211. Environmental Geology Laboratory. (0-3) 1 Credit Hour. (TCCN = GEOG 1105)
Laboratory studies to accompany Environmental Geology Lecture. Selected laboratories pertaining to urban and regional land use planning. Generally offered: Fall and Spring. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STFE $40; STSI $7.20.

ES 1213. Environmental Geology. (3-0) 3 Credit Hours. (TCCN = GEOG 1305)
The earth as a habitat. Interrelationships between humans and the environment. Geologic factors in urban and regional land use planning. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall and Spring. Course Fees: IUS1 $15; L001 $30; LRS1 $46.20; STSI $21.60.

ES 1314. Environmental Statistics. (3-3) 4 Credit Hours. (TCCN = MATH 1442)
Collection, analysis, presentation, and interpretation of environmental data, and probability. Analysis includes descriptive statistics, correlation and regression, confidence intervals and hypothesis testing. Use of appropriate technology, including statistical software. Generally offered: Fall and Spring. Course Fees: IUS1 $15; LRS1 $61.60; STSI $28.80.

ES 2013. Introduction to Environmental Science I. (3-0) 3 Credit Hours. (TCCN = ENVR 1301)
An introduction to the scientific principles, concepts, and methodologies needed to understand the interactions of the biotic component of the natural world, to identify and analyze environmental problems within the biotic component of natural world, risk assessment of these environmental problems, and to examine alternate solutions. General attention is given to the biotic concepts of growth, processes, and changes occurring in ecosystems and social structures. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall, Spring. Course Fees: DL01 $75; LRC1 $12; LRS1 $46.20; STSI $21.60.

ES 2021. Introduction to Environmental Science I Laboratory. (0-3) 1 Credit Hour.
Prerequisite: Concurrent enrollment in ES 2013 is recommended. Qualitative and quantitative methods in the study of biotic environmental systems. Generally offered: Fall, Spring. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20.

ES 2023. Introduction to Environmental Science II. (3-0) 3 Credit Hours. (TCCN = ENVR 1302)
An introduction to the scientific principles, concepts, and methodologies needed to understand the interactions of the abiotic component of the natural world, to identify and analyze environmental problems within the abiotic component of the natural world, risk assessment of these environmental problems, and to promote environmental sustainability. General attention is given to the abiotic environmental factors including natural hazards, pollution processes, energy resources, sustainability, and changes occurring in ecosystems. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall, Spring. Course Fees: LRC1 $12; LRS1 $46.20; STSI $21.60; DL01 $75.

ES 2031. Introduction to Environmental Science II Laboratory. (0-3) 1 Credit Hour.
Prerequisite: Concurrent enrollment in ES 2023 is recommended. Qualitative and quantitative methods in the study of abiotic environmental systems. Generally offered: Fall, Spring. Course Fees: IUS1 $15; L001 $30; LRS1 $15.40; STSI $7.20.

ES 2113. Fundamentals of Geographic Information Systems (GIS). (2-2) 3 Credit Hours.
This course will serve as a basic introduction to the concepts and techniques of utilizing a Geographic Information System (GIS) to study and model environmental issues. In lecture and laboratory, students will study methods of querying, analyzing, creating, and displaying GIS data utilizing industry standard software. Students will also be introduced to using the Global Positioning System (GPS) as a means for creating GIS data. Generally offered: Fall and Spring. (Same as GEO 2113. Credit cannot be earned for both ES 2113 and GEO 2113.) Course Fees: IUS1 $15; LRS1 $46.20; STSI $21.60.

ES 3033. Environmental Ecology. (3-0) 3 Credit Hours.
Prerequisites: ES 2013 and ES 2023, or equivalents. Examination of the interactions of biotic and abiotic systems, including interactions of plants, animals, and the environment. (Formerly ES 3034. Credit can only be earned for one of the following: ES 3033, ES 3034, or BIO 3283.) Generally offered: Fall, Spring. Differential Tuition: $150.

ES 3042. Environmental Ecology Laboratory. (0-6) 2 Credit Hours.
Prerequisites: ES 2013, ES 2021, ES 2023, and ES 2031, or equivalents; concurrent enrollment in ES 3033 is recommended. A field-oriented course emphasizing modern ecological techniques, including examinations of plant and animal populations and measurement of selected chemical and physical parameters. (Same as BIO 3292. Credit cannot be earned for both ES 3042 and BIO 3292.) Generally offered: Fall, Spring. Differential Tuition: $100. Course Fees: IUS1 $15; L001 $30; STFE $40.

ES 3053. Environmental Remediation. (3-0) 3 Credit Hours.
Prerequisites: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. This course will focus on the fundamentals associated with environmental remediation in relation to the overall environmental quality and protection. Topics covered include contaminant fate and transport; physical, chemical, and biological processes/characteristics of the air, soil, and water; remediation/restoration methods; environmental monitoring; environmental assessments; environmental regulations; and water/wastewater treatment. (Formerly ES 3054. Credit cannot be earned for both ES 3053 and ES 3054.) Generally offered: Spring. Differential Tuition: $150.

ES 3073. Environmental Rhetoric and Technical Communication. (3-0) 3 Credit Hours.
Prerequisite: ENG 2413. Restricted to students who have completed 60 or more hours. This course focuses on rhetoric, ecology, and technical/scientific communication in order to develop interdisciplinary, team-based, and applied research projects. This advanced professional writing and rhetoric course will examine ecological communications as an archetypal example of specialized technical communication. (Same as BIO 3073. Credit cannot be earned for both ES 3073 and BIO 3073.) Generally offered: Fall, Spring. Differential tuition: $150.
ES 3103. Environmental Microbiology. (3-0) 3 Credit Hours.
Prerequisites: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents; or consent of instructor. This course will survey environmental microbiology and will emphasize microbial interactions in terrestrial and aquatic environments as well as the fate of microbial pathogens. Topics covered include microbial environments, detection of bacteria and their activities in the environment, microbial biogeochemical cycling, bioremediation of organic and inorganic pollutants, and water quality. (Formerly ES 3104. Credit can only be earned for one of the following: ES 3103, ES 3104, or BIO 3713.) Generally offered: Fall. Differential Tuition: $150.

ES 3113. Ichthyology. (3-0) 3 Credit Hours.
Prerequisites: ES 2013, ES 2021, ES 2023, and ES 2031, or equivalents. Study of fishes, and includes a wide range of topics including taxonomy, systematics, and biogeography, anatomy and physiology, and behavior and ecology. This course will focus on form and function, behavior, life history, ecology, and key taxonomic characteristics of many of the orders of fishes. Field trips may be required. Same as BIO 3113, credit cannot be earned for both BIO 3113 and ES 3113. Generally offered: Spring. Differential Tuition: $150. Course Fees: IUS1 $15; STFE $40.

ES 3121. Introduction to Soils Laboratory. (0-3) 1 Credit Hour.
Prerequisites: CHE 1083 and CHE 1093, or equivalents. Laboratory exercise and field trips designed to develop student competency in soil description, analysis, and assessment. Generally offered: Fall and Spring. Course Fees: IUS1 $15; L001 $30. Differential Tuition: $50.

ES 3123. Introduction to Soils. (3-0) 3 Credit Hours.
Prerequisites: CHE 1083 and CHE 1093, or equivalents. A study of soil properties and processes and relationships to land use, plant growth, environmental quality, and society. Generally offered: Fall and Spring. Differential Tuition: $150.

ES 3133. Oceanography. (3-0) 3 Credit Hours.
Prerequisite: ES 1213 or equivalent. Description of the oceans. Emphasis on relations of biology, chemistry, geology, and physics in marine environments. Examination of relationships and interactions at macro and micro scales in the ocean. Field trips may be required. (Same as GEO 3163. Credit cannot be earned for both ES 3133 and GEO 3163.) Generally Offered: Spring of even years. Differential Tuition: $150.

ES 3141. Watershed Processes Laboratory. (0-3) 1 Credit Hour.
Prerequisites: ES 2013, ES 2023, ES 1213, and ES 2113, or equivalents. Laboratory exercises and field trips designed to develop an understanding of watershed processes, watershed assessment, and watershed management. Generally offered: Fall and Spring. Differential Tuition: $50. Course Fees: IUS1 $15; L001 $30; STFE $40.

ES 3143. Watershed Processes. (3-0) 3 Credit Hours.
Prerequisites: ES 2013, ES 2023, ES 1213, and ES 2113, or equivalents. This course focuses on watershed processes, watershed assessment, and watershed management. Generally offered: Fall and Spring. Differential Tuition: $150. Course Fee: STFE $40.

ES 3153. Environmental Chemistry. (3-0) 3 Credit Hours.
Prerequisites: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. This course explores the chemistry of the environment, the chemistry underlying environmental problems, and solutions to environmental problems. Emphasis is placed on thermodynamics and kinetics of reaction cycles; sources, sinks, and transport of chemical species; and quantitation of chemical species. Examples are selected from the chemistry of natural and contaminated air, water, and soil. (Same as CE 4613. Credit cannot be earned for both ES 3153 and CE 4613.) Generally offered: Spring. Differential Tuition: $150.

ES 3163. Ornithology. (3-0) 3 Credit Hours.
Prerequisite: ES 2013 and ES 2023, or equivalents. A course covering various aspects of the biology of birds, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 4063. Credit cannot be earned for both ES 3163 and BIO 4063.) Generally offered: Spring of even years. Course Fees: Differential Tuition: $150. Course Fee: IUS1 $15.

ES 3173. Mammalogy. (3-0) 3 Credit Hours.
Prerequisite: ES 3033 or BIO 3283, or equivalents. A course covering various aspects of the biology of mammals, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 3293. Credit cannot be earned for both ES 3173 and BIO 3293.) Generally offered: Fall of odd years. Differential Tuition: $150. Course Fee: IUS1 $15.

ES 3183. Entomology. (3-0) 3 Credit Hours.
Prerequisite: ES 3033 or BIO 3283, or equivalents. A course covering various aspects of the biology of insects, including anatomy, physiology, evolution, behavior, ecology, and biogeography. (Same as BIO 3303. Credit cannot be earned for both BIO 3303 and ES 3183.) Generally offered: Spring odd years. Field trips may be required. Differential Tuition: $150.

ES 3193. Herpetology. (3-0) 3 Credit Hours.
Prerequisite: ES 3033 or BIO 3283, or equivalents. A course covering various aspects of the biology of amphibians and reptiles, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 3353. Credit cannot be earned for both ES 3193 and BIO 3353.) Generally offered: Fall of odd years. Differential Tuition: $150. Course Fee: IUS1 $15.

ES 3203. Environmental Law. (3-0) 3 Credit Hours.
Present-day environmental enabling acts and regulations will be covered, with emphasis on federal acts, such as the National Environmental Policy Act, Clean Water Act, Resource Conservation and Recovery Act, and associated regulations. Generally offered: Fall and Spring. Differential Tuition: $150.

ES 3213. Biology of Flowering Plants. (2-3) 3 Credit Hours.
Prerequisite: Junior or senior status; a minimum of 60 semester credit hours. A study of the wildflowers of Texas emphasizing identification of the more common wildflowers, as well as family characteristics, flower anatomy, plant morphology, and plant-collecting techniques will be included. Lecture, laboratory, and fieldwork will be included as part of the course. (Same as BIO 3273. Credit can only be earned for ES 3213 or BIO 3273.) Generally offered: Spring. Differential Tuition: $150. Course Fees: L001 $30; STFE $40.

ES 3223. Woody Plants. (2-3) 3 Credit Hours.
Prerequisite: Junior or senior status; a minimum of 60 semester credit hours. A study of the woody plants emphasizing the characteristics of family, genus, and species. Includes identification of the common woody plants. Leaf, stem, and flower morphology, anatomy, and collecting techniques. Lecture, laboratory, and fieldwork will be included as part of the course. (Same as BIO 3263. Credit cannot be earned for both ES 3223 and BIO 3263.) Generally offered: Fall. Differential Tuition: $150. Course Fees: L001 $30; STFE $40.

ES 3233. Survey of Insects. (3-0) 3 Credit Hours.
Prerequisites: ES 2013 and ES 2023 with a grade of at least a 'C'. Restricted to students who have completed 60 or more hours. A course covering various aspects of the biology of insects, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 3233. Credit cannot be earned for both ES 3233 and ES 3273.) Generally offered: Fall of odd years. Differential Tuition: $150. Course Fee: IUS1 $15.
ES 3253. R Coding in Environmental Science and Ecology. (3-0) 3 Credit Hours.
Prerequisite: ES 2113. Restricted to students who have completed 60 or more hours. This course will teach the management of environmental and ecological data using Program R. The focus will be on the structure and linguistics of data in R and how to integrate R into a data science workflow. (Same as BIO 3253. Credit cannot be earned for both ES 3253 and BIO 3253.) Generally offered: Spring even years. Differential Tuition: $150.

ES 3303. Sustainable Development. (3-0) 3 Credit Hours.
Prerequisite: ES 2013 and ES 2023. Restricted to students who have completed 60 or more hours. This course will focus on addressing the challenges of sustainability and development with actionable knowledge for innovating solutions to the world's most pressing problems like climate change, poverty and inequality, and biodiversity loss and ecosystem degradation. Generally offered: Spring even years. Differential Tuition: $150.

ES 3313. Advanced Geographic Information Systems (GIS). (3-0) 3 Credit Hours.
Prerequisite: ES 2113 or equivalent. This course is an undergraduate level course directed at developing more advanced Geographic Information Systems skills. The class is not introductory, and students will begin using more advanced analysis tools in ESRI GIS software (ArcGIS 10.3). Applications of the technology for scientific discovery and exploration will be used as case study examples. Generally offered: Fall of odd years. Differential Tuition: $150.

ES 3953. Topics in Environmental Science. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Field trips may be required. May be repeated for credit when topics vary. Generally offered: Fall and Spring. Differential Tuition: $150.

ES 4023. Aquatic Ecology. (3-0) 3 Credit Hours.
Prerequisites: ES 3033 and ES 3042, or equivalents. A survey of physiological approaches to understanding plant-environment interactions from the functional perspective. (Same as BIO 4303. Credit cannot be earned for both ES 4023 and BIO 4303.) Generally offered: Fall of even years. Differential Tuition: $150.

ES 4033. Plant Physiological Ecology. (3-0) 3 Credit Hours.
Prerequisites: ES 3033 and ES 3042, or equivalents. A survey of physiological approaches to understanding plant-environment interactions from the functional perspective. (Same as BIO 4313. Credit cannot be earned for both ES 4033 and BIO 4313.) Generally offered: Fall of even years. Differential Tuition: $150.

ES 4103. Global Change. (3-0) 3 Credit Hours.
Prerequisites: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents; and junior or senior status. Changes in the global distribution of plants and animals and the causes of the changes will be examined. Factors that are apparently coupled to changes in these distributions will be examined including, but not limited to, atmospheric composition change and temperature change. Additionally, examination of the impact of humans and their activities on the environment: their effect on aquatic, marine, and terrestrial plant, animal, and human resources. (Formerly ES 4104. Credit cannot be earned for both ES 4103 and ES 4104.) Generally offered: Fall and Spring. Differential Tuition: $150.

ES 4111. Field Biology Laboratory. (0-3) 1 Credit Hour.
Prerequisite: Junior or senior status: a minimum of 60 semester credit hours, or consent of instructor; concurrent enrollment in ES 4113 is recommended. A field-oriented course offering the opportunity for practical experience observing, collecting, and identifying Texas plants and animals. (Same as BIO 4241. Credit cannot be earned for both ES 4111 and BIO 4241.) Generally offered in Summer. Differential Tuition: $50. Course Fee: IUS1 $15.

ES 4113. Field Biology. (3-0) 3 Credit Hours.
Prerequisite: Junior or senior status: a minimum of 60 semester credit hours, or consent of instructor; concurrent enrollment in ES 4111 is recommended. A study of the natural history of plants and animals in their native environment. Techniques for the identification of birds, mammals, reptiles, amphibians, insects, and the dominant flowering plants will be discussed. (Same as BIO 4233. Credit cannot be earned for both ES 4113 and BIO 4233.) Generally offered: Summer. Differential Tuition: $150. Course Fee: IUS1 $15.

ES 4123. Desert Biology. (3-0) 3 Credit Hours.
Prerequisite: Junior or senior status: a minimum of 60 semester credit hours, or consent of instructor. An introduction to wildlife biology and management including ecological principles dealing with ecosystems, natural communities, and populations. The importance of animal behavior, the availability of food, cover, wildlife diseases, predators, hunting, and trapping will be included. Field studies will allow students to observe and apply classroom topics. (Same as BIO 4043. Credit cannot be earned for both ES 4123 and BIO 4043.) Generally offered: Summer. Differential Tuition: $150. Course Fee: IUS1 $15.

ES 4133. Natural Resource Policy and Administration. (3-0) 3 Credit Hours.
Prerequisite: Junior or senior status. Factors in evolution of forest, range, wildlife, and related natural resources administration and policies in the United States; policy components; policy formation implementation, administration, and change processes; introduction to criteria for evaluating effectiveness of policies and administration. Same as BIO 4233; credit cannot be earned for both BIO 4233 and ES 4133. Generally offered: Spring. Differential Tuition: $150.

ES 4153. Introduction to Sustainability. (3-0) 3 Credit Hours.
Prerequisites: ES 2023 and junior or senior status: a minimum of 60 semester credit hours, or consent of instructor. This course will examine the major environmental issues and trends happening in modern society from a scientific and practical perspective, including biodiversity, population, food and water resources, climate change, energy, public health, and the overall forecast for the environment for the next several decades. Differential Tuition: $150. Course fee: DL01 $75.

ES 4163. Renewable Energy. (3-0) 3 Credit Hours.
Prerequisites: ES 2023 and junior or senior status: a minimum of 60 semester credit hours, or consent of instructor. This course is an introduction to energy systems and renewable energy resources, with a scientific examination of the energy field and an emphasis on alternate energy sources and their technology and application. Generally offered: Fall of even years. Differential Tuition: $150.

ES 4173. Waste Water Treatment. (2-3) 3 Credit Hours.
Prerequisite: ES 2023 and junior or senior status: a minimum of 60 semester credit hours, or consent of instructor. The application of chemical, biochemical, and physical processes to water treatment, wastewater treatment, and pollution control. Generally offered: Spring of even years. Differential Tuition: $150. Course Fees: IUS1 $15; STFE $40.
ES 4183. Environmental Toxicology. (3-0) 3 Credit Hours.
Prerequisites: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. Examination of advanced or specialized hazardous or toxic waste treatment methods. Emphasis will be on physical, chemical, and biological processes in treatment and processing of hazardous waste materials. Generally offered: Spring. Differential Tuition: $150.

ES 4193. Planning and Response to Environmental Disasters. (3-0) 3 Credit Hours.
Prerequisites: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. Mitigation of preparation for, response to, and recovery from environmental disasters. Generally offered: Fall of even years. Differential Tuition: $150.

ES 4203. Environmental Assessment. (3-0) 3 Credit Hours.
Prerequisites: ES 2013 and ES 2023, or equivalents. This course evaluates the framework of an impact assessment and details regarding the environment (air, water, soil), its pollutants (atmospheric, noise, water, solid waste), their impacts (physical, social, economic), relevant regulations, and pollution minimization or management strategies. Students use this information to review and comment on an existing Environmental Impact Statement (EIS). Generally offered: Fall and Spring. Differential Tuition: $150.

ES 4212. Senior Seminar. (2-0) 2 Credit Hours.
Prerequisite: Senior status. Environmental Science majors and a minimum of 90 credit hours. The techniques of seminar presentation will be studied by preparing and presenting individual seminars on topics of interest. Enrollment for credit is limited to, and required of, all senior students majoring in environmental studies. (Formerly ES 4211. Credit cannot be earned for both ES 4212 and ES 4211.) Generally offered: Fall and Spring. Differential Tuition: $100.

ES 4213. Conservation Biology. (3-0) 3 Credit Hours.
Prerequisite: ES 3033 or BIO 3283, or equivalents. The class topics will include studying the nature of the biosphere, threats to its integrity, and ecologically sound responses to these threats. Also included will be the origin and preservation of biotic diversity, how the rich variety of plant and animal life around us arose, how it has been maintained by natural processes, and how we can prevent its destruction. (Same as BIO 4033. Credit cannot be earned for both ES 4213 and BIO 4033.) Generally offered: Spring. Differential Tuition: $150. Course fee: DL01 $75.

ES 4223. Urban Wildlife Ecology. (3-0) 3 Credit Hours.
Prerequisites: ES 3033 and ES 3042, or equivalents. Fundamentals of urban ecology, field methods including urban wildlife and human surveys, and urban wildlife management and conservation strategies. Generally offered: Fall of even years. Differential Tuition: $150.

ES 4233. Restoration Ecology. (3-0) 3 Credit Hours.
Prerequisite: ES 3033 or BIO 3283, or equivalents. Applies ecological principles to the restoration of disturbed terrestrial, wetland, and aquatic ecosystems. Includes the restoration of soils and waterways, of flora and fauna, and of natural ecological processes such as plant succession and nutrient cycling. (Same as BIO 4323. Credit cannot be earned for both ES 4233 and BIO 4323.) Generally offered: Spring. Differential Tuition: $150.

ES 4243. Wildlife Ecology. (3-0) 3 Credit Hours.
Prerequisite: ES 3033. Major environmental factors affecting wildlife; structure, and behavior of wildlife populations; regional wildlife communities and their conservation. (Same as BIO 4053. Credit cannot be earned for both ES 4243 and BIO 4053.) Generally offered: Spring even years. Differential Tuition: $150.

ES 4253. Sources, Fate, and Transport of Chemicals in the Environment. (3-0) 3 Credit Hours.
Prerequisites: ES 2013, ES 2023, and MAT 1093, or equivalents. Sources of chemicals in the environment. Processes regulating fate and transport of metals, organics, nutrients, salts, pathogens, and radionuclides in the environment. Generally offered: Fall and Spring. Differential Tuition: $150.

ES 4263. River Ecosystems. (3-0) 3 Credit Hours.
Prerequisite: ES 3033 with a grade of at least a 'C'. This course examines the physical, chemical, and biological factors that determine biodiversity and the structure and function of aquatic and riparian ecosystems. Key ecological and hydrogeomorphology concepts and their application to environmental concerns are covered. (Same as BIO 4263. Credit cannot be earned for both BIO 4263 and ES 4263.) Generally offered: Spring of even years. Differential Tuition: $150.

ES 4273. Fish Ecology. (3-0) 3 Credit Hours.
Prerequisite: ES 3033 with a grade of at least a 'C'. A study of the biotic and abiotic factors affecting the diversity and distribution of fishes, with a focus on North American freshwater fishes. This course will include (1) lectures and discussions covering patterns and processes in fish ecology; and (2) a collaborative research project covering computational techniques used in fish ecology. (Same as BIO 4273. Credit cannot be earned for both BIO 4273 and ES 4273.) Generally offered: Fall of even years. Differential Tuition: $150.

ES 4283. Plant-Soil-Microbe Interactions. (3-0) 3 Credit Hours.
Prerequisite: ES 3033 with a grade of at least a 'C'. Restricted to students who have completed 60 or more hours. This course focuses on the microbial groups which live in soils and among plant species and methodologies used to understand their interaction. (Same as BIO 4283. Credit cannot be earned for both BIO 4283 and ES 4283.) Generally offered: Spring of odd years. Differential Tuition: $150.

ES 4293. Human Dimensions of Wildlife Management. (3-0) 3 Credit Hours.
Prerequisite: ES 3033. This course will introduce students to the role that humans play in the management of wildlife and how people’s knowledge, values, and behaviors influence conservation decisions. Students taking this course will develop an understanding of the social, political, and economical drivers of wildlife management. They will also explore ways to engage stakeholders in wildlife management through conservation tools and effective communication that considers human dimensions. An emphasis will be placed on working with private landowners, and in so doing train students to work in private landscapes where culture, society, politics, and economics often provide the context for management decisions. Generally offered: Spring even years. Differential Tuition: $150.

ES 4303. Principles of Wildlife Management. (3-0) 3 Credit Hours.
Prerequisite: ES 4243. Ways of conserving desired numbers of animals for the overall best interests of society, be they aesthetic, ecological, economic, commercial, or recreational; includes management of endangered species, exploited species, wildlife communities in nature reserves, and wildlife pests. Generally offered: Spring even years. Differential Tuition: $150.

ES 4503. Introduction to Environmental Risk Assessment. (3-0) 3 Credit Hours.
Prerequisite: ES 4183 with a grade of "C" or better. This course will offer hands-on training in the primary areas of risk assessment (i.e., hazard identification, dose-response assessment, exposure assessment, and risk characterization). Generally offered: Fall of odd years. Differential Tuition: $150.
ES 4513. Advanced Environmental Risk Assessment. (3-0) 3 Credit Hours.
Prerequisite: ES 4503 with a grade of at least a 'C-'. This course will offer hands-on training in the advanced areas of risk assessment (i.e., hazard identification, dose-response assessment, exposure assessment, and risk characterization). Generally offered: Spring of even years. Differential Tuition: $150.

ES 4911. Independent Study. (0-0) 1 Credit Hour.
Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: $50.

ES 4912. Independent Study. (0-0) 2 Credit Hours.
Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, Summer. Differential Tuition: $100.

ES 4913. Independent Study. (0-0) 3 Credit Hours.
Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, and Summer. Differential Tuition: $150.

ES 4953. Special Studies in Environmental Science. (3-0) 3 Credit Hours.
Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: variable. Differential Tuition: $150. Course fee: DL01 $75.

ES 4963. Internship. (0-0) 3 Credit Hours.
Prerequisite: Consent of the Undergraduate Advisor of Record. An opportunity for students to work in a setting that permits them to apply what they have learned in the formal instruction part of the program. Generally offered: Fall, Spring, Summer. Differential Tuition: $150.